SCIENTIFIC AMERICAN

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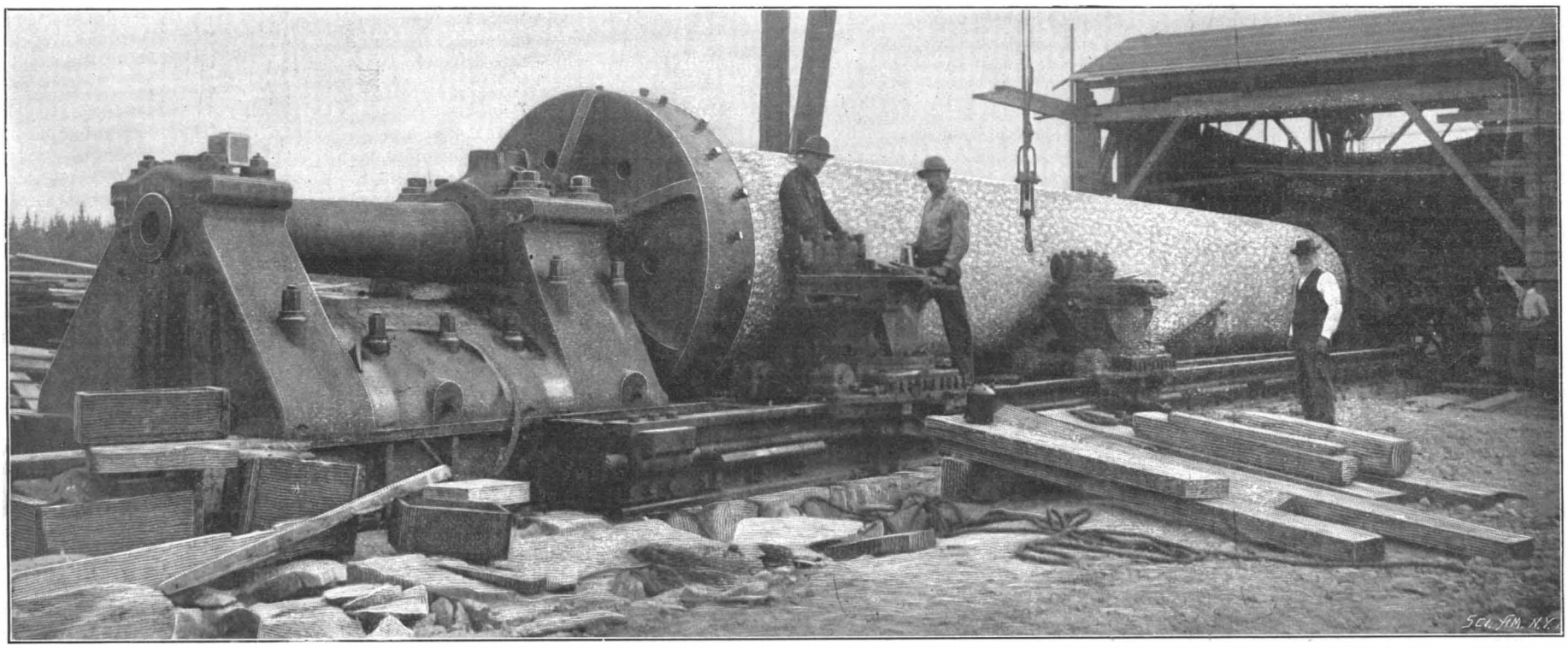
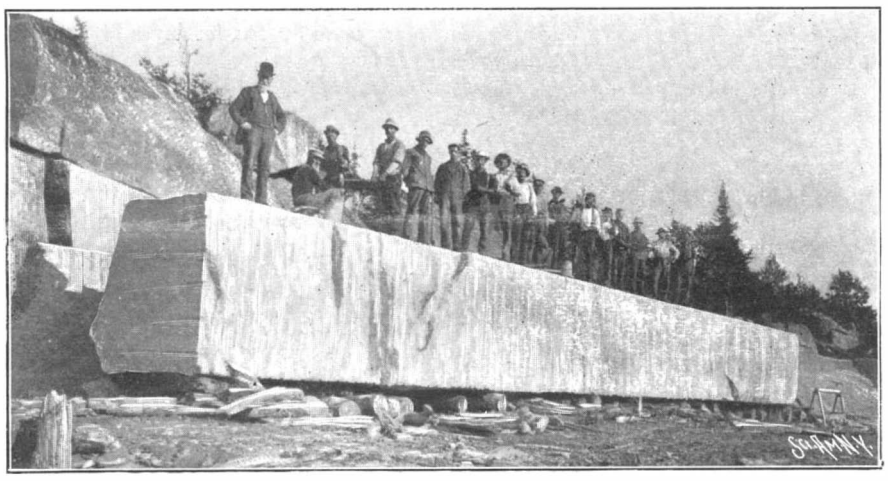
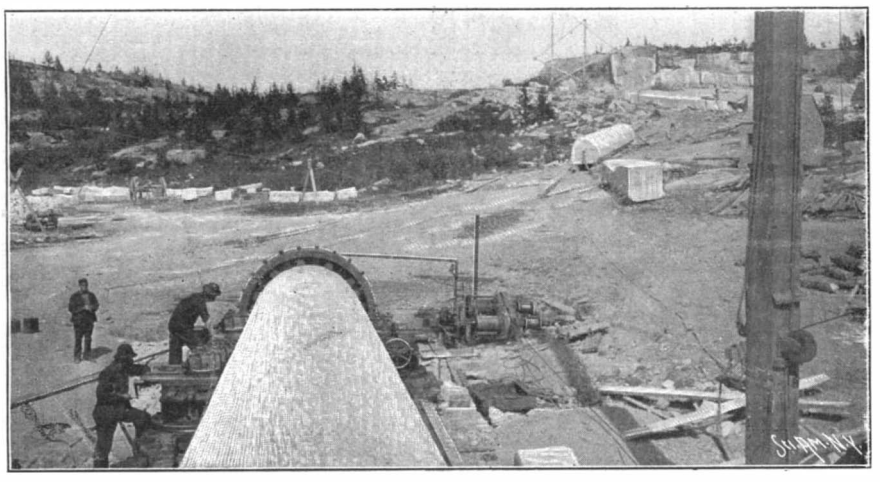


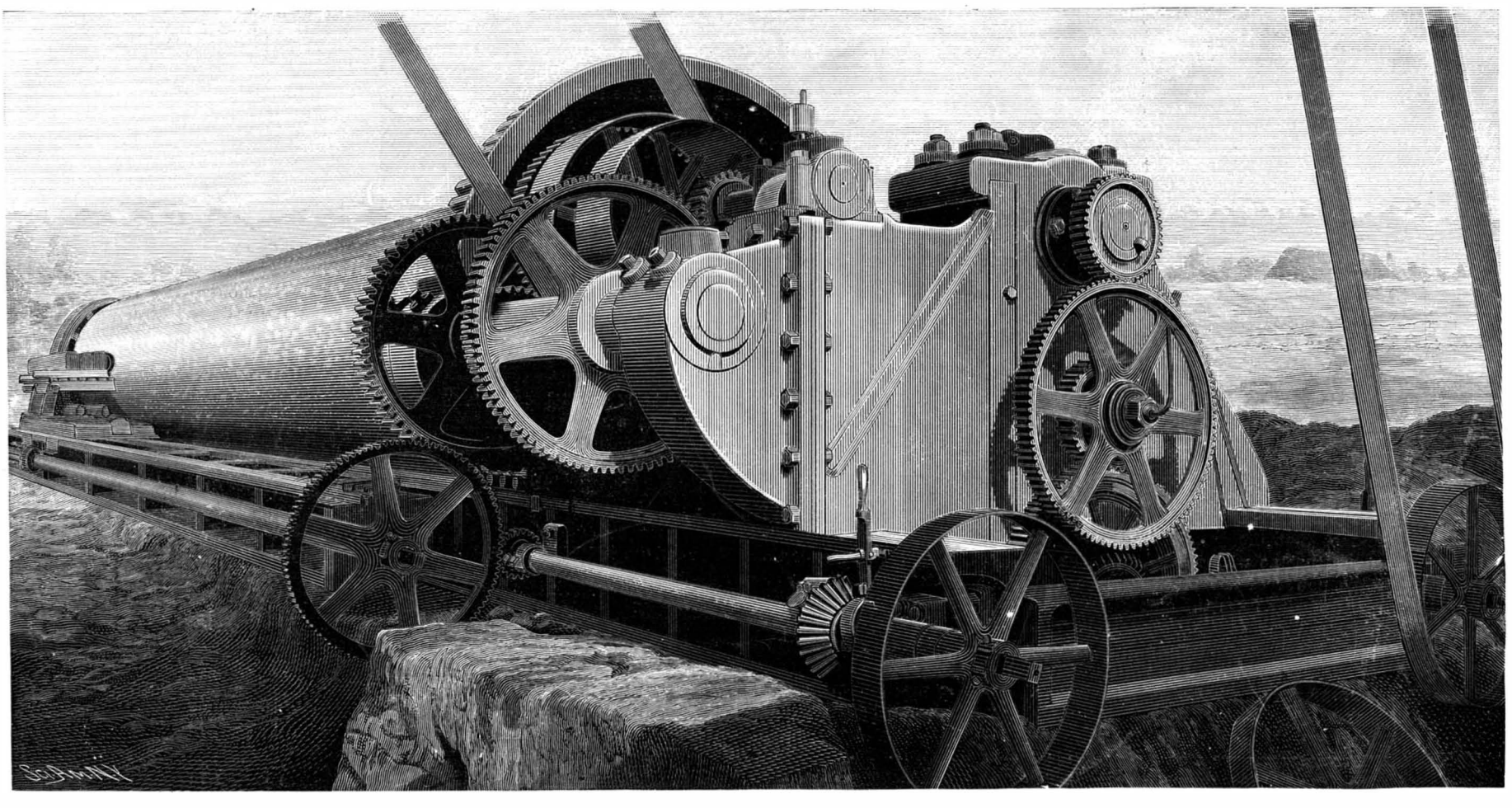
The Lathe Turning the First Column—View of Tailstock.



Blank for Column 64 Feet Long, 8 Feet 6 Inches by 7 Feet.



View Looking Down the Column.



The Lathe Turning the First Column—The Headstock.

The finished columns are 54 feet long and 6 feet in diameter; weight, 160 tons. Lathe weighs 135 tons, swings 6 feet 6 inches by 60 feet long. The eight cutters each take a 3-inch cut, thus reducing the column 24 inches at one cut.

TURNING THE GREAT COLUMNS FOR THE CATHEDRAL OF ST. JOHN THE DIVINE.—[See page 22.]

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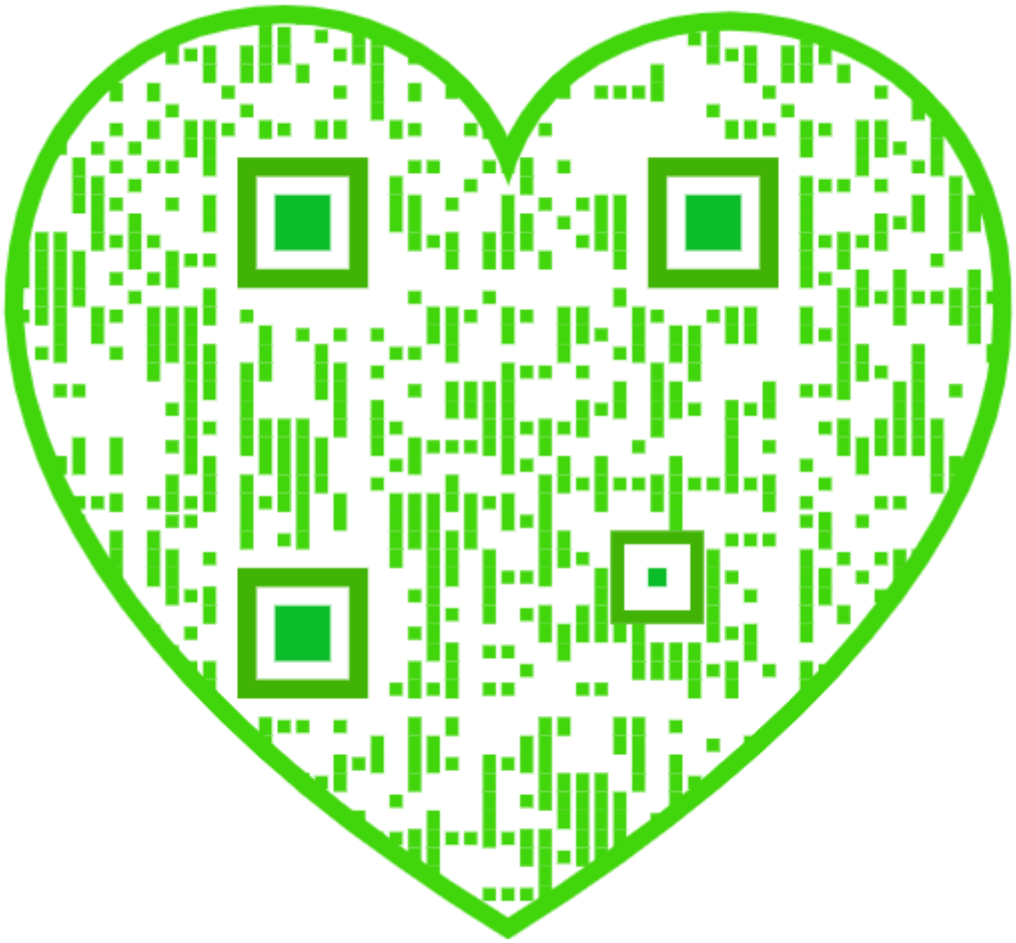

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NEW YORK, SATURDAY, JANUARY 12, 1901.

THE EFFICIENCY OF THE STEAM TURBINE.

The communication from the Hon. Charles A. Parsons, which we publish in our correspondence columns, will be read with great interest by every one that is interested in the development of the steam turbine, whose performance in the closing years of the nineteenth century affords reason to believe that it is to be the steam motor of the twentieth. We would draw particular attention to the economy shown in the two 1,000-kilowatt turbine plants at Elberfeld, Germany, where the trial tests revealed a steam consumption of 11.9 pounds per indicated horse power per hour. In this connection mention may be made of the comparative test carried out recently of the Parsons turbines installed in the works of the Westinghouse Air-Brake Company, where the old reciprocating steam engine plant and the new turbine plant were each run for a week, careful measurements being made of fuel and water. During the day the saving in coal shown by the turbines averaged 35.7 per cent, and the saving in feed water 29.8 per cent, the economy being in great measure due to the turbines, and in part to the electrical transmission.

The paper read by Prof. Thurston, at the recent annual meeting of the American Society of Mechanical Engineers, on the steam turbine, is at once an emphatic tribute to the excellent work which has already been accomplished by the steam turbine, and a prediction of its future triumph. The author's opinion of this form of motor, considered as a prime mover, is evidently summed up in the title of the paper: "The Steam Engine of Maximum Simplicity and of Highest Thermal Efficiency."

It is not possible to give here any extended review of this valuable article, which is published in the current issue of the SUPPLEMENT, and it will be sufficient to summarize the results of the tests and give the final conclusions. In the test of a Parsons compound turbine made by Prof. Ewing in August, 1892, the consumption when making use of superheated steam and a jet condenser fell to about 16 pounds per indicated horse power per hour. Recent trials with the Parsons turbine constructed by the Westinghouse Machine Company, of this country, give the following economy of steam, the steam being practically dry during the trials. At full load, 16.4 pounds of steam were consumed per electric horse power per hour; at ¾ load, 17 pounds; at ½ load, 18.2 pounds; and at ¼ load, 22 pounds of steam per electrical horse power per hour. Regarding these remarkable results, Prof. Thurston says: "It will be particularly interesting to observe that the loss of efficiency with decreasing loads is less marked than with the common forms of engine." From a table published by the Continental European representatives of the De Laval Steam Turbine Society, showing the consumption of dry steam, we gather that the consumption in a condensing De Laval turbine varied from 34.8 pounds in a 3-horse power engine to 15.8 pounds per horse power per hour in a 300-horse power engine. In tests of the De Laval turbine reported by Prof. Goss, the lowest result obtained with 10.33 brake horse power was 47.8 pounds of steam per brake horse power per hour. The tests of a 50 horse power De Laval turbine by Prof. Cederblom at Stockholm showed a consumption of 19.7 pounds of steam per horse power per hour at the brake. In this connection Prof. Thurston draws attention to the fact that the gain in economy progresses in the steam turbine with increasing loads up to the limit of the power of the machine, in which respect it departs markedly from the case of the common forms of engine. The Curtis steam turbine is reported as having given a performance with 130 pounds steam pressure, and 28 inches of vacuum, of 24 to 27 pounds of steam per brake horse power per hour.

The conclusions of the paper are:

First: The steam turbine thermodynamically approximates in its real form more closely to the ideal than does any other type of heat motor. Its cycle lacks only the introduction of the Carnot compression.

Second: It is entirely free from that waste which, in the real steam engine of common type, constitutes usually, if not invariably, the most important of its extra thermodynamic losses.

Third: It is peculiarly well fitted for use with those very high steam pressures as we now regard them, which must ultimately be resorted to by the engineer in his endeavor to improve the efficiency of heat engines.

Fourth: It is limited in speed of rotation only by the strength of its materials of construction.

Fifth: It is especially suitable for use with superheated steam, it having no rubbing parts on which lubrication may be difficult, and the limit of superheating being found only at that point at which increased temperature of metal produces an objectionable amount of reduction of tenacity. The limit of superheat is fixed with this machine at the boiler itself.

Sixth: Friction is peculiarly active for evil in this motor, and it must be guarded against by using small diameters of journal, by freedom from contact of part with part, by the minimizing of fluid friction by the use of superheated steam, and by the removal, as far as practicable, of the atmosphere, air, or vapor from about the revolving wheel.

Seventh: The wastes of the steam turbine are all extra thermodynamic, with the exception of the loss due to the absence of adiabatic recompression. They consist of (a) journal friction, which is made a minimum by the use of flooded bearings and a light unguent; (b) fluid friction between the disk and the leakage of steam or suspended moisture in the jet, which may be made a minimum by superheating; and fluid friction between the disk and its inclosing atmosphere of vapor, which may be minimized by the employment of a good condenser; (c) loss of heat and of steam by leakage which may be reduced to a minimum by durable material, fine workmanship and close fits; (d) waste by incomplete expansion; and finally (e) thermodynamic waste by failure to secure complete adiabatic recompression of the fluid—a peculiarly difficult matter in steam turbines, since it probably involves the employment of a separate vapor-compression pump, and an amount of added work and cost which may introduce losses more than compensating its gains.

THE SHIP-SUBSIDY BILL.

There are some questions of great national importance which, because of their complexity and the many side issues which attach to them, are peculiarly liable both to misunderstanding and misrepresentation. To this class belongs the ship-subsidy bill, a measure which has been defined and explained by its friends with a clearness of definition, and an honesty of purpose, that are only equaled by the misrepresentation (much of which we are willing to believe is quite unintentional) with which it has been clouded by its enemies.

The confusion of ideas regarding the present state of our shipping interests is due largely to the fact that, in much of the written and spoken discussion of the subject, there has been no distinction made between those shipping interests which are protected and those which are not. To avoid such confusion, we will ask our readers to omit from the present consideration that portion of our shipping which is included under the term "lake and coastwise," and to bear in mind, also, that in excluding this we exclude by far the largest portion of the tonnage that carries the flag of the United States. Our lake and coastwise shipping must be omitted for the reason that it is secured against foreign competition by a sweeping law which forbids any foreign ships from engaging in this particular; trade; the fostering effect of which law is seen in the fact that our lake and coastwise traffic is both healthy and highly remunerative, and is increasing by leaps and bounds.

When we come to consider our merchant marine, however, we find that it is exposed to the direct competition of maritime nations, who are able to build and operate their ships at a cost so much lower than ourselves, that any hope of successful competition is out of the question. The ship-subsidy bill has been drafted with the idea of affording such assistance to the merchant marine as shall place it on equal terms of competition with the rest of the world.

It is a matter of fact, as we shall show, that under existing conditions the United States cannot compete successfully with other nations either in the first cost, the cost of maintenance, or the cost of operation, of ocean-going steamers. It is a matter of opinion, whether, as a question of broad, far-seeing policy, the Treasury of the United States should render to the shipowners such temporary financial assistance, in the early years of a serious and determined effort to move up to our proper position among the maritime nations of the world, as will place us on equal terms, and give us a reasonable hope of being ultimately able to maintain and improve our position without such national aid. It is a matter of fact that although the cost of the crude material for shipbuilding is not materially greater in this country than abroad, the cost of labor is so considerably greater that there is an ultimate difference in cost per ton of the ship at the date of her launching in favor of the foreign builder of at least 20 per cent. It is a fact that whereas the "Pleiades," a 3,750-ton cargo steamer, of 9¾ knots speed, which has the distinction of being considerably the cheapest cargo steamer ever built in this country, cost $275,000, the British steamer "Masconomo," of 4,200 tons, and 10 knots speed, cost only $217,000. It is a fact, moreover, that while the annual charges on the "Pleiades," based on the cost of construction, amount to $44,000, the annual charges on the "Masconomo" amount to only $34,240. It is a matter of fact that while the total annual wages paid to the crew of the "Pleiades" amounts to $14,580, the total annual wages paid out on the "Masconomo" amounts to only $11,751, while the total wages paid out in one year to the British ship "Pinedene," of about the same size and type as the others named, amounts to only $9,505. It is a matter of fact that a mass of statistics, gathered and digested by the Commissioner of Navigation for the United States, shows that in the cost of construction of cargo steamers there is an average difference in favor of Great Britain of 20 per cent, and in cost of operation of 33 1-3 per cent. It is a matter of fact that the possibility of carrying on a profitable competition under such unequal conditions has discouraged the investment of capital in our merchant marine, and has diverted it into the more promising channel offered by our protected and flourishing lake and coastwise trade. It is a matter of fact that owing to the stagnation of our merchant marine we are now paying out annually, at a conservative estimate, $240,000,000 to foreign shipowners for carrying our rapidly increasing exports across the seas.

In the presence of these facts we are confronted by the question as to whether it is consistent with the commercial interests of the nation, to say nothing of its proud traditions, that we should be beholden to a foreign flag for the transport to foreign markets of the multiplied products of our fields and factories. The ship-subsidy bill has been drawn up under the conviction that, contemporaneously with the present enormous increase in our manufactured exports, there should be a determined national effort to resuscitate our merchant marine, and place ourselves in a position where we can act as the carriers of our own products and thus secure the rich returns upon our industries, in their entirety, where now so much of it is diverted elsewhere. On the other hand, the opponents of the bill profess to be perfectly satisfied with the existing situation, and quite willing to allow the foreigner, as long as he can carry our goods more cheaply than ourselves, to do so.

Without making any obvious comment upon the unprogressive spirit which lies behind such an attitude, we offer the following considerations: First, that such an attitude means the practical abandonment of any considerable development of deep sea shipping in America. Secondly, that this involves that the United States must be destitute of any numerous or adequate auxiliary merchant marine. Just what this implies may be best understood by reference to the deplorable muddle into which our transportation was thrown, when we put our little army into Cuba, and endeavored at the close of the war to bring the disease-smitten victims home again. A numerous auxiliary merchant marine is an indispensable accessory to distant foreign possessions; and it is a fact that, although we disdain to designate our little affair in the Philippines by the name of "war," it has lately been necessary for our Quartermaster Department to charter, in addition to our considerable fleet of trans ports, no less than forty vessels to carry supplies to the Philippines alone. Lastly, we invite consideration of the fact that if Great Britain, which acts so largely as our carrier on the high seas, were to be at war with us, a contingency which, though unlikely and greatly to be deprecated, is yet a possibility that must never be lost sight of, we should be utterly unable to get our vast and rapidly increasing exports out of the country. Germany could carry but a part of it, and her commercial instincts are not so altruistic but that she would make haste, by an enormous increase in rates, to reap a rich harvest. The loss from this source alone would amount to more than the annual amount of subsidy asked by the present bill for many years to come.

The question before us, then, may be stated succinctly as follows: Is it desirable that the nation as a whole should transfer from the national treasury to the individual shipowners the money equivalent ($9,000,000 a year) of the actual disadvantages under which our shipowners labor as compared with the shipowners of a competing nation? After a careful review of the whole situation, it appears to us that such a policy, if carefully followed out for a period of years, would so far stimulate ocean-going shipbuilding, that the decreased cost of production due to increased output, the decreased fixed charges, and the decreased cost of operation due to improved ships and better methods, would enable us sooner or later, and rather sooner than later, to dispense with the subsidy and take our place as one of the great maritime nations of the world.

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THE THIRTEENTH ANNUAL MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA.

BY EDMUND O. HOVEY.

The thirteenth annual meeting of the Geological Society of America was held in the assembly hall of the Albany (Boys) Academy on December 27, 28 and 29, 1900, under the presidency of Dr. G. M. Dawson, C.M.G., F.R.S., director of the Geological Survey of Canada. About fifty fellows of the society were in attendance, which was considered a large number, in view of the distance of the place of meeting from the large centers of population on the Atlantic seaboard. Thirty-eight papers were presented for reading, eleven of which were read by title only, on account of the absence of their authors. The comparatively small number of papers actually read gave ample opportunity for discussion, and this was a very valuable feature of the meeting. The address of welcome by the Hon. T. Guilford Smith, chairman of the State Museum Committee and member of the Board of Regents of the State University, was historical in character and dwelt especially upon the little known Geological Society of Pennsylvania, which had a very brief existence in 1835 and 1836, and was the first geological society formed in this country. In the address of welcome by Dr. F. J. H. Merrill attention was called to the fact that the sessions of the society were being held in the meeting room of the old Albany Institute, which was an active patron of science for many years and which originated the movement which resulted in the establishment of the geological and palæontological survey of the State of New York many years ago. Dr. J. M. Clarke, the other member of the local committee, in his welcoming speech spoke of the fact that the room in which the present meeting was held was the one in which Prof. Joseph Henry made his famous and historic demonstration of the electric telegraph. Forty-four years had passed since the last preceding general meeting of geologists had taken place in Albany.

Dr. Dawson's presidential address was entitled "On the Geological Record of the Rocky Mountain Region in Canada" and gave a succinct resumé of the results of thirty years study of that vast area by the Geological Survey of Canada, which began under Dr. A. R. C. Selwyn and James Richardson and has been continued by Dr. G. M. Dawson and Messrs. Amos Bowman, J. McEvoy, R. G. McConnell, J. B. Tyrrell, R. W. Brock and J. C. Gwillim and their assistants. The Cordilleran region in Canada is much narrower than that of the United States, being only about 400 miles in width, and the mountain ranges preserve a quite close parallelism with the coast of the Pacific Ocean, and the geological features accord with the physical. The result of this is that the geological horizons have great longitudinal extent, while their transverse section is comparatively narrow. The region falls into five natural sub-divisions: the Laramide geosyncline, comprising the Rocky Mountains proper, forming a belt sixty miles wide along the eastern border of the Cordillera; west of this a belt 140 miles wide, made up of a somewhat irregular and sometimes interrupted series of mountain systems to which the general name of the gold ranges has been applied, and embracing the Purcell, Selkirk, Columbia and Cariboo Mountains; still further west the interior plateau of British Columbia, which has a breadth of 100 miles and is well-defined for a length of about 500 miles, with an average elevation of about 3,500 feet; still further west the coast ranges of British Columbia, which form a belt 100 miles in width and extend along the border of the Pacific for more than 900 miles, beginning near the estuary of the Fraser River; finally, the long, ridge-like highlands of Vancouver Island and the Queen Charlotte Islands, which stand upon the real border of the continental plateau. Dr. Dawson then took up in order each of the great geological systems represented in the region and discussed its features and phenomena in detail, bringing his address to a close with the following words:

The most striking points evidenced by the geological record of the Rocky Mountain region of Canada may be summarized as follows:

There was an enormous thickness of strata accumulated, both to the east and to the west of the Archæan axis. In the Laramide geosyncline (that of the Rocky Mountains proper) the beds no doubt attained the full thickness of more than 46,000 feet. In the western and wider geosyncline it is not so certain that all the formations were ever actually superposed at any place or time, but their volume cannot have been less than those in the Laramide geosyncline, and their total measured thickness is much greater.

There is a great proportion of volcanic materials in the western geosyncline and the region is characterized by the recurrence of vulcanism throughout the geological time-scale, resulting in the production of massive volcanic formations in the Cambrian, Carboniferous, Triassic, Cretaceous and Miocene.

The recurrence of folding and disturbance parallel to the border of the Pacific Ocean basin and the concurrent great changes in elevation of the land relatively to the sea both continued down to quite recent geological times, the latter even into the Pleistocene.

There are tremendous energy of denudation, in part due to the events just referred to, but also dependent upon the position of the region on the eastern border of a great ocean, where in northern latitudes an excessive rainfall must have occurred at all periods on the westernmost mountain ranges. No comparable denuding has been probably exercised on the eastern side of the continent in similar latitudes since the definition of the Pacific and Atlantic Ocean basins.

During the year the society has lost one member by death, Franklin Platt, of Philadelphia, who was one of the six assistants chosen by J. P. Lesley to undertake the second geological survey of Pennsylvania. He chose bituminous coal as his field of work, but afterward left the pursuit of pure science and went into commercial life as the head of a coal company.

Eleven new members have been added to the society's lists and the present enrollment is 248. The new officers for the ensuing year are: president, Charles D. Walcott; and vice-presidents, N. H. Winchell and S. F. Emmons. The next meeting of the society will be held in connection with Section E of the American Association for the Advancement of Science in Denver next August. The annual dinner of the society was the usual informal, enjoyable affair, under the leadership of Prof. B. K. Emerson. An account of the Albany meeting would not be complete without an appreciative mention of the elaborate reception tendered to the society by Dr. F. J. H. Merrill, State Geologist of New York, which gave the members opportunity to meet many of the best known of Albany citizens. Abstracts of the papers read at the business sessions of the society will shortly appear in the SCIENTIFIC AMERICAN SUPPLEMENT.

PROPOSED IMPROVEMENTS AT THE SAULT STE. MARIE CANAL.

The first ship canal around the rapids of the Sault Ste. Marie was built by the State of Michigan, and completed in 1855 at a cost of nearly $100,000. It was but 350 feet in length and contained two locks, but in its time it served greatly to stimulate trade on the Upper Lakes. The rapid development of the Lake Superior country and the consequent increase of commerce soon taxed the capacity of the canal. In 1881 the old canal was superseded by one of modern proportions. The single lock was 515 feet in length, with a width of 60 feet at the gates and 80 feet in the chamber and a depth of 14 feet over the sills. The total cost was $2,150,000.

The opening of this second canal relieved the congestion only temporarily; for great as was the tonnage passing this point during the period of the old canal's existence, from 1855 to 1881, the growth of traffic during the next period was even more rapid. In 1870, after the old canal had been open 15 years, the total annual tonnage was 691,000 tons. In 1894, when a third canal was built, the tonnage had risen to 13,110,363 tons per annum. In the meanwhile the Canadian canal at this point had been opened to traffic. The third American canal, which is now to be enlarged, is composed of two locks; the larger, the Poe Lock, having a length of 800 feet and a width of 100 and a depth over sills of 20 feet 6 inches; and the Weitzel Lock, with a length of 600 feet. The improvements to be recommended at the next session of the Rivers and Harbors Committee of Congress provide for the enlargement of the Weitzel Lock to a length of 1,600 feet, a width of 100 feet, and a depth over the sills sufficient to accommodate the largest lake vessel either afloat or building at the time the work is begun. These plans, which will undoubtedly be carried out during the next few years, will make this canal connecting these two great lakes by far the most important in the world. Through this channel of traffic there passes in eight months of the year a tonnage greatly in excess of that which passes through the Suez Canal or enters the port of London, or of New York, during a year.

Two-score years ago there were less than 1,000 lockages annually through the canal. During the past season there were often that many per week. The lockages for the season aggregated nearly 20,000. Of the vessels carrying traffic through this canal, some 4,000 in number, all save about one-twenty-fifth were American vessels. The total value of the cargoes carried through this canal annually is nearly a quarter of a billion dollars. In favorable seasons freight is carried at a rate of less than one mill per ton for each mile transported—about one-third of the lowest railroad rate. The tonnage of the Sault Ste. Marie canals for the past year exceeds 25,000,000 tons.

The importance of the Sault Ste. Marie canals in interlake commerce is little appreciated. The canals have assisted in the great development of the lake carrying trade in cereals and copper and iron ore. In four years the traffic in iron ore has increased from less than 150,000 tons to more than 11,000,000 tons annually, and in the same time there has been built up a trade in coal on Lake Superior of more than 3,000,000 tons annually. Even the last lock constructed by our government at Sault Ste. Marie was not designed with a view to the present great demands. Hence the numerous blockades of vessels, which have proved exceedingly costly to ship-owners and merchants. The enlargement of the canal now proposed will obviate these annoyances and provide adequate facilities. But these improvements will be only a part of the great plan for the development of lake commerce. Already our government has spent about $7,500,000 in canal construction at this point, and an additional $3,000,000 has been expended in the maintenance of the canal. The improvements now planned will bring the grand total of expenditures of the United States government to nearly $20,000,000.

MOVING PICTURE LITIGATION.

The question of priority in moving picture patents has just come up for argument in the United States Circuit Court for the Southern District of New York, the suit being brought by Mr. Edison against the American Mutoscope Company. The patent, for which the suit was brought, was No. 589,168, granted August 31, 1897, to Mr. Edison, and its claims alleged to be infringed are numbers one, two, three and five. The first three claims deal with the picture taking machine, including the single lens camera, the single tape-like film and the rapid-feed movement for feeding the film and turning on and off the light. The fifth claim embodies the continuous translucent film with the pictures upon it. The brief and arguments state that by employing a single lens camera the pictures were all taken from the same point of view and by making the movable part of the apparatus a tape-like film, the necessary high speed for securing the required large number of pictures per second could be produced without duplication of the film, and this film could be given the considerable length necessary for the continuous taking of pictures over an extended period of time without increasing the weight of the moving parts unduly. The resulting picture strip possessed all the essential characteristics for successful use in an exhibiting apparatus, and permitted of the direct printing of positives upon a similar film. The strip thus produced had pictures taken from the same point of view and arranged in a continuous straight line sequence throughout the length of the film and equi-distant from each other, thus permitting of its use in simple and practical forms of exhibiting apparatus. The complainants stated that a single tape-like film that could be moved with sufficient rapidity to secure the rapid succession of photographs with a single lens was an epoch-making invention. The idea was conceived by Mr. Edison in 1889, but the development of the idea and the formation of the company required so much time that it was not until 1894 that he placed upon the market machines employing the picture film made on his camera. The films and machines were on the market for two years when the great success of the enterprise caused others to enter the field.

The defense contended that the apparatus was based on the "persistence of vision," which had been known for a century, and that the claims in the patents referred to had been anticipated by prior patents and in printed matter. The prior state of the art was reviewed at great length. It was contended that many moving picture cameras for using long tape-like films had been invented before Edison's alleged invention, and that the rapid progress in the art of recent years was the result of the invention of the Eastman celluloid film and was not particularly due to the apparatus devised by Edison. A decision will probably be rendered in a few weeks.

DEATH OF LORD ARMSTRONG.

Sir William George Armstrong, first Lord Armstrong, who died on December 27, 1900, was one of a little group of inventors and manufacturers who have made modern armament what it is. He was born in 1810, and he early took deep interest in science and mechanics. He invented the hydro-electric machine, a most powerful means of developing frictional electricity. For this he was elected a Fellow of the Royal Society. His next inventions were an electric crane, and the accumulator by which an artificial head of water is substituted for the natural head, gained only by altitude. He greatly extended the application of hydraulic power to a variety of purposes, and finally with some friends founded the Elswick Engine Works. In 1854 he first became known as an inventor of war material. In that year he put out the gun which bears his name, and presented the patents to the government, and he was knighted in recognition of his unselfish patriotism. His system was extended to guns of all sizes, the primary principle being the coiling of one wrought iron tube over another until a sufficient thickness has been reached. The Elswick company is one of the largest manufacturing concerns of its kind in the world, and is taking a leading part in the development of artillery and other implements of war. Sir William was given a peerage in 1887.

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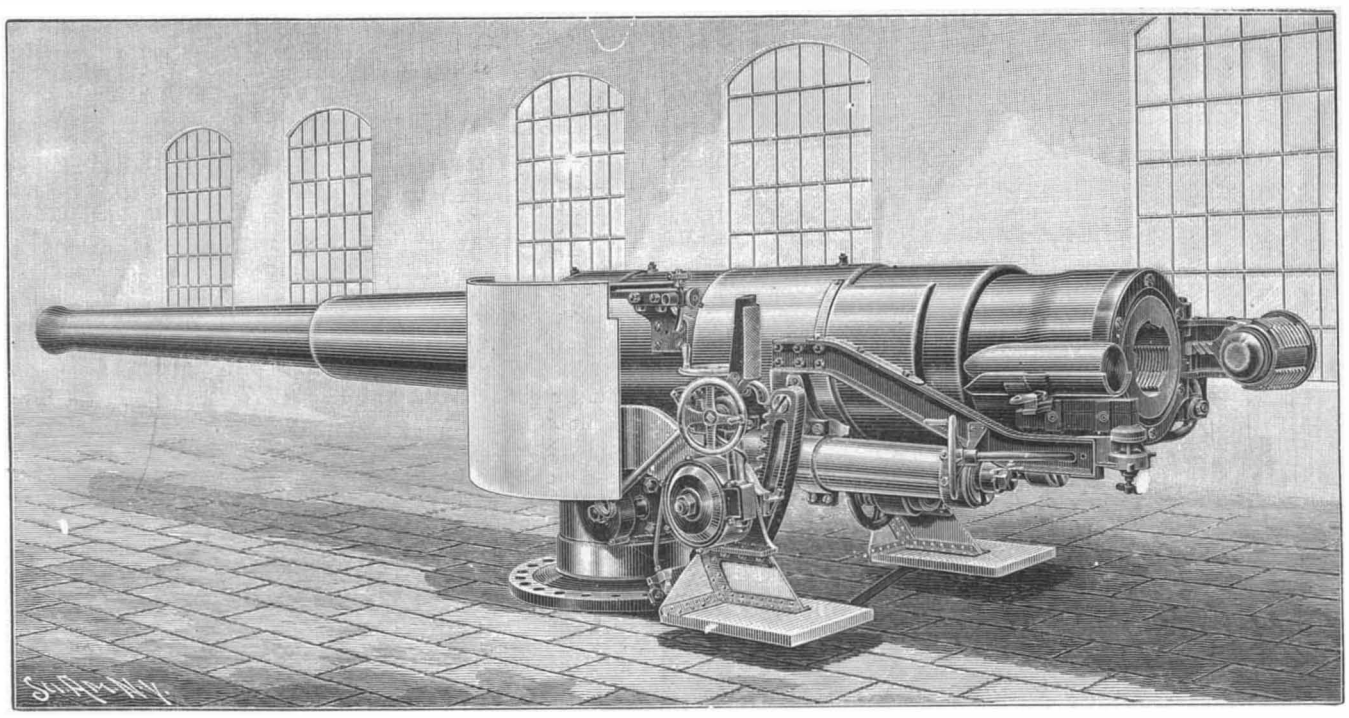
A NEW QUICK-FIRING GUN.

The really wonderful improvement in the resisting power of light armor of five and six inches thickness, such as covers the waterline and guns of modern cruisers, and the secondary batteries of warships, has emphasized the necessity of providing a gun intermediate in weight and power between the 8-inch breech-loading rifle and the 6-inch rapid-fire gun—a weapon that shall embody something of the armor-penetrating ability of the one with the rapidity of fire of the other It is certain that the 6-inch gun is incapable of penetrating the best Krupp armor at ordinary fighting ranges even if it happens to strike a blow normal to the surface. On the other hand the long caliber 8-inch gun is more than equal to the task; moreover, the weight of the ammunition of the latter weapon is such as to prevent the attainment of the desired rapidity of fire.



THE NEW VICKERS-MAXIM 7.5-INCH RAPID-FIRE GUN.

The 7.5-inch gun herewith illustrated was built to meet the demand for a weapon intermediate between the 8-inch and the 6-inch. It was built by Vickers, Sons & Maxim, Limited, of Sheffield, England. Its design is similar to that of the 4.7 quick-firing gun with which the British navy has been so extensively armed. The gun itself is 386.7 inches in total length with a bore 7.5 inches in diameter. It is constructed on the wire-wound principle, and, including gun, breech-mechanism, shield, and mounting, represents a weight of 26 tons 15½ cwt. Its principal dimensions and ballistics are as follows:

Length of bore	375	inches = 50 calibers.
Diameter	7.5	"
Length of chamber	54.25	"
Diameter	11	"
Weight of gun and mechanism	16	tons 1 cwt.
Weight of mounting complete with 3-inch shield	10	" 14½ "
Weight of cordite charge	50	pounds.
Weight of projectile	200	"
Maximum pressure	17	tons.
Muzzle velocity (feet per second)	2,920	
Muzzle energy (foot tons)	11,825	

The angle of elevation is 16 degrees, and of depression 10 degrees, while the rapidity of firing is six rounds per minute. The center pivot upon which the gun is mounted consists of a steel top carriage resting on a horizontal roller bearing on a steel pivot. The cradle in which the gun is free to slide during recoil is cylindrical, and attached to the cradle are three cylinders, one to overcome the recoil, and the other two—one on each side of the recoil cylinder—contain the springs for running the gun up to the firing position after the recoil. The connection between these three cylinders and the gun is made by arms projecting from the breech ring. The whole weight of the moving parts, gun, cradle, and carrriage, is balanced on the roller bearing before referred to, thus making the training of the gun very easy. The elevating and training operations are performed by the rotation of two handwheels placed conveniently to the shoulderpiece against which the gunner leans. Anti-friction bearings are used where most required, so that these operations are easily and readily performed, notwithstanding the tremendous weight of the mass to be moved.

The recoil cylinder differs in no particular from those usually employed. The shield which is shown in our illustration, and which is 3 inches in thickness with a gross weight of 2 tons 1 cwt., is of the usual casemate pattern. An electric contact is fixed on the cradle, and it is so arranged that unless the gun is in the firing position it cannot be fired. The sighting arrangement is so adjusted that only a small aperture in the shield is necessary.

The most salient characteristics of this type of mounting are as follows: Increased protection from shell fire by the construction of the top carriage, which is of considerable thickness, and the general arrangement of the several parts are well disposed and are under exceptional protection. They are also in few parts, and easily kept in repair, thus necessitating very little attention.

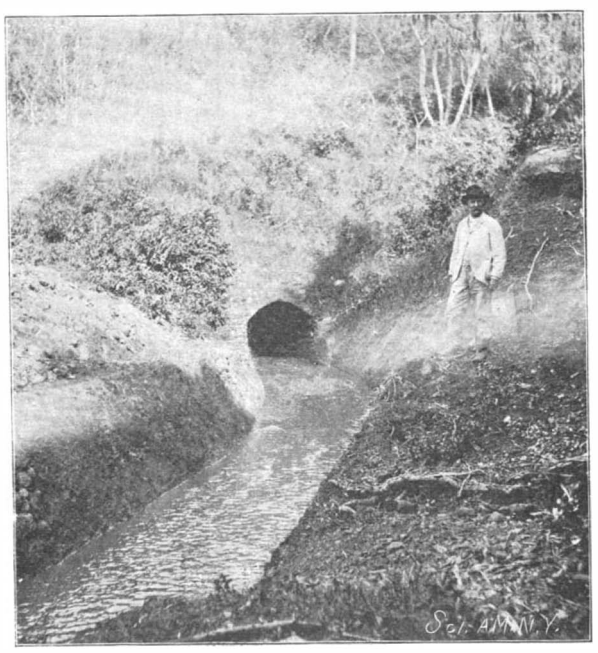
The loading gear consists of a shot tray pivoted on a bar at one side of the cradle so as to move with the gun during elevation or depression, and capable of swinging on its axis in such a manner that the longitudinal axis of the tray is always parallel to the axis of the gun. The tray is controlled by a worm and worm wheel gear, actuated by a handwheel suitably mounted near the breech; on the left hand side of the gun a clutch is provided so that the worm gear may be put out of action if necessary and the tray controlled by hand only if desired. A safety arrangement is provided to insure that the loading gear and the breech-mechanism will not collide during the operation of either, and that the gun cannot be fired until the loading gear is out of the line of recoil.

IRRIGATION IN THE HAWAIIAN ISLANDS.

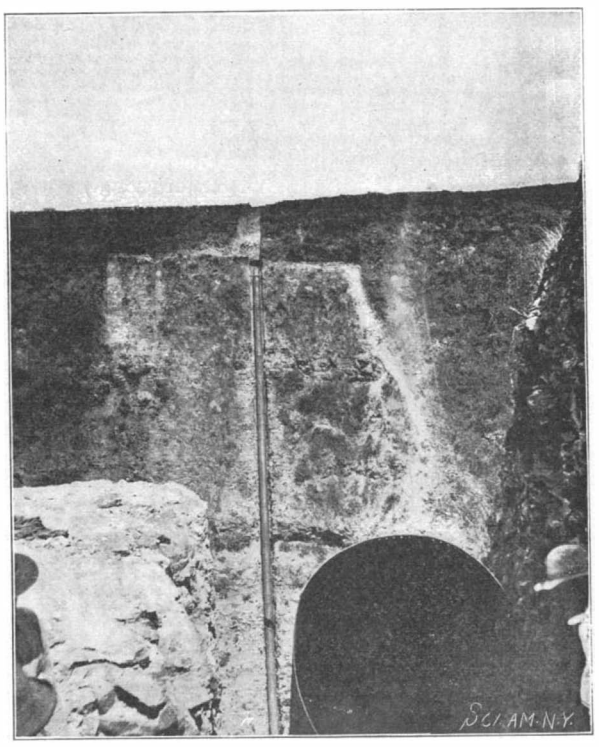
On the island of Maui, one of the larger islands of the Hawaiian group, an engineering feat has just been successfully carried through that has not its equal in the Pacific Islands. To supply water to the Spreckelsville plantation, a canal has been dug along the slopes of the great crater of Haleakala, and by it a stream of water flowing 50,000,000 gallons daily is brought a distance of 22 miles and thence distributed over the plantation lands.

It was no ordinary undertaking, the building of this great canal, for in those 22 miles from Kailua Gulch to Spreckelsville there were gluches and canyons by the score, each of which had to be crossed, and there were a dozen or more high ridges to pass, through which it was necessary to dig tunnels, some of which were nearly half a mile in length. But thanks to the energy of the manager of the plantation, the ditch was plowed and successfully carried through. By its means 6,000 acres of cane land was reclaimed; land which had before been considered waste and barren; where nothing grew but lantana bushes and here and there a few algerobas. In another year it is likely that all this land will be placed under cultivation and will flourish with green cane.

Some statistics with reference to the canal will be of interest. Work on the ditch was begun on July 28, 1899, and the water was flowing through it on September 6, 1900. The work of completing the ditch had been much delayed, owing to the epidemic of plague which afflicted the islands in the past spring. Its actual length, from Kailua Gulch, where the water is taken out, to the boundaries of Kihei plantation, at the farther side of Spreckelsville plantation, is 21.9 miles. In this distance there are no less than 74 tunnels, with an aggregate length of 20,850 feet, or nearly 4 miles. The longest of these tunnels is 1,955 feet in length, and there are several which run over 1,000 feet. Of open excavation, there are 85,957 feet, and



View Showing Portion of Ditch and One of the Tunnels.



Large Syphon Across Maliko Gulch. Diameter of pipe, 44 inches; length, 815 feet; depth of gulch, 350 feet.

Kailua Waterfall. All of this is Conserved by the Ditch.

LOWRIE IRRIGATION DITCH; HAWAIIAN ISLANDS.

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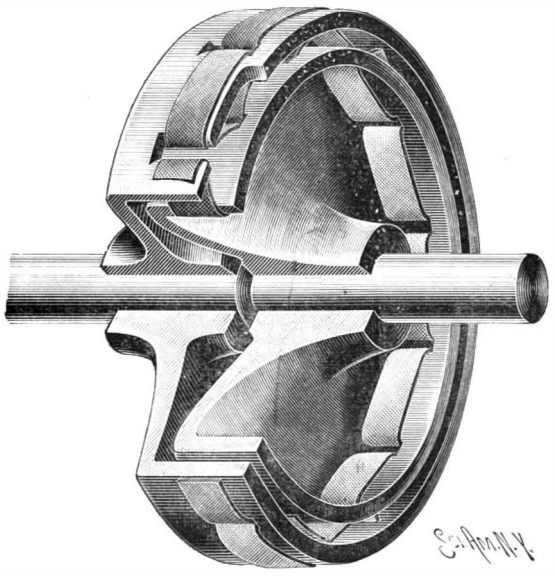
there are 19 flumes whose length aggregates 1,965 feet.

But the most striking feature of the ditch is the manner in which it is carried over the numerous gulches which scar the sides of the great extinct crater. Some of these gulches are very deep, and their sides are nearly perpendicular. To cross them pipe lines are used, not stretched across on trestles, but following the less expensive and more stable method of dropping into the gulches and allowing the water to



THE ZODEL FLEXIBLE COUPLING.

flow on the principle of the inverted siphon. Of these siphons there are twelve along the line of the ditch, all built of quarter-inch pipe, 44 inches in diameter. Their aggregate length is 4,760 feet, or nearly one mile. The largest of them crosses Maliko Gulch, a gash in the slope of the volcano which stretches nearly from the summit to the sea, and which is 350 feet deep and less than a quarter of a mile wide. Across this gorge it seemed next to impossible to carry a siphon, but Engineer E. L. Van Der Neillen, who planned the ditch and carried it successfully to completion, succeeded in doing the work. A photograph taken a week before the completion of the ditch is published with this article.

The completion of this great canal, which has been named the Lowrie Irrigating Canal, after the gentleman who conceived it and pushed it to a successful finish, marks a new era in Hawaii. By it have been demonstrated the possibilities in bringing water from distant spots in the rain belts, of which each of the islands boasts, to the comparatively dry regions which constitute a great portion of the area of many of them. The Lowrie Canal cost $250,000, but it will mean rich returns to the stockholders in the plantation which it supplies with water; and other plantations all over the group will doubtless emulate the example of the enterprising manager of Spreckelsville and put in similar irrigating canals. WADE WARREN THAYER.

THE ZODEL FLEXIBLE COUPLING.

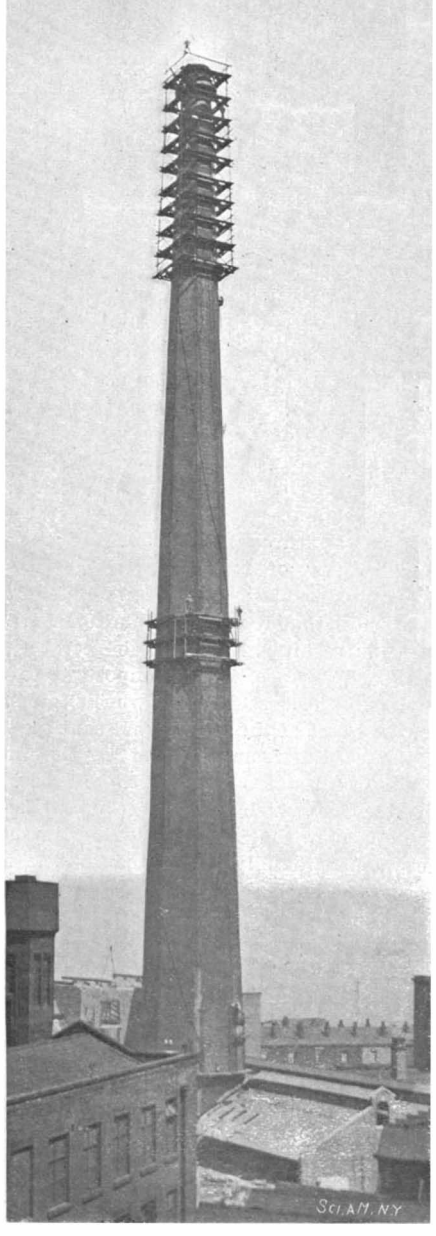
The firm of Escher, Wyss & Company, of Zurich, Switzerland, made a fine exhibit at the Paris Exposition of engines, refrigerating machinery and paper-making machines. Among the novelties which were shown by them was the Zodel flexible coupling, which is extensively used on the Continent for the direct coupling of dynamos, turbines, etc. Two disks provided with flanges are secured to the ends of the two shafts which are to be coupled. The flanges, one of them lying inside the other, are perforated by a series of slots through which is threaded a leather or a cotton belt, so that the short stretches of belt lying between the flanges have a nearly tangential position, so that they effectively transmit the tangential driving effort without waste tension in the belt. The Engineer, from which we derive our information, states that the coupling appears to work smoothly, and the belt is said to have a long life in it.

A SIMPLE METHOD OF BROACHING BRASSES AND BEARINGS.

The brasses or bearings used on car-journals are ordinarily turned on an engine-lathe—a process which requires no little time and some skill. A machine has been patented by Mr. Jason A. Baker, of 1505 Liberty Avenue, Houston, Tex., which forms these brasses and bearings at a single stroke, and which is so far automatic that the operator has merely to control certain water and air-pressure valves.

The machine comprises a cylinder containing a piston driven on the down-stroke by water-pressure, and on the up-stroke by air-pressure. The piston-rod at its upper end carries a broaching-head comprising two circular cutters separated by a collar, so that first the lower cutter and then the upper cutter passes through the brasses on the down-stroke of the piston. The brasses or bearings are therefore cut, contrary to the usual method, at a single stroke. A centering-ring is employed to hold and center the brasses while they are cut. In addition to its reciprocating movement, the broaching-head has a turning motion imparted by an arrangement consisting of an arm secured to the piston-rod, which arm carries a roller traveling on a spirally-arranged track. When the piston moves down, the roller in traveling on its track turns the broaching-head. If it be desired to reverse the movement of the piston-rod, the arm is adjusted so that the roller travels under a second track extending in a direction opposite to that of the first.

The upper end of the cylinder is connected with a water-supply pipe, and the lower end of the cylinder with a valved air-pressure pipe. An outlet pipe leads from the water-supply for the escape of the water from the cylinder, the valves of these two pipes (serving respectively to regulate the inflow and outflow of water) being controlled by a common lever. The motor employed is actuated solely by water-pressure.

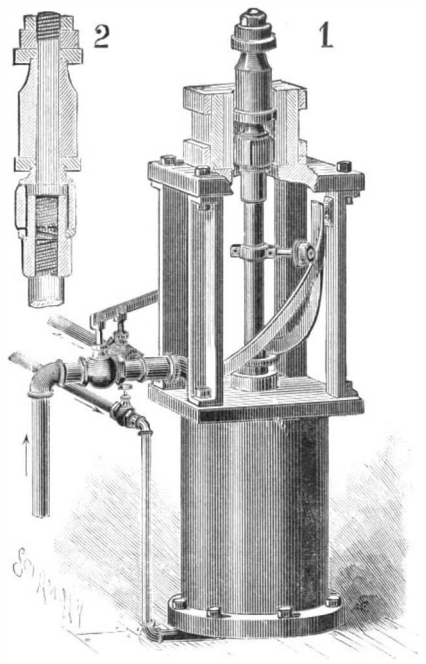


SECOND TALLEST CHIMNEY IN ENGLAND—HEIGHT, 367½ FEET.

THE BUILDING AND REPAIRING OF TALL CHIMNEYS.

The building and repairing of tall chimneys offer engineering problems of considerable magnitude. One of our engravings represents the repairs to the second tallest chimney in England, and our other engraving shows the novel staging used in the construction of a chimney built by the Plume & Atwood Manufacturing Company, at Thomaston, Conn. The latter chimney is 150 feet high, 15 feet in diameter at the base and 9 feet at the top. It is built of red brick with an inside flue of firebrick which reaches quite to the top. The staging was designed by Mr. J. M. Chatfield, of Thomaston, and is held in place by two bands which are made in eight sections. Each section, which is 38 inches long, is constructed of two parallel pieces of iron 38 inches long, 3 inches wide, and a quarter of an inch thick, fastened horizontally 9 inches apart, to five wooden uprights or staves 18 inches long and 1¼ inches thick which come into direct contact with the chimney. To each end of the flat iron pieces is riveted one leg of a piece of angle iron; the opposite legs, at right angles with this band, are fitted with long bolts connected with the adjoining section in like manner. The bolts are threaded throughout their entire length, 30 inches, and serve to hold the section together, and tighten or loosen the band around the chimney, allowing the space between the sections to decrease or increase as the band is moved up or down the chimney.

To each section in the upper band is bolted a wooden bracket. The upper end of the bracket is 10 feet long and extends below the lower band. Blocks prevent the uprights from moving sideways; these blocks are fastened to the band, forming a groove in which the upright slides as the band is moved up and down. The horizontal members of the brackets extend out 5 feet at right angles to the uprights and are raised a

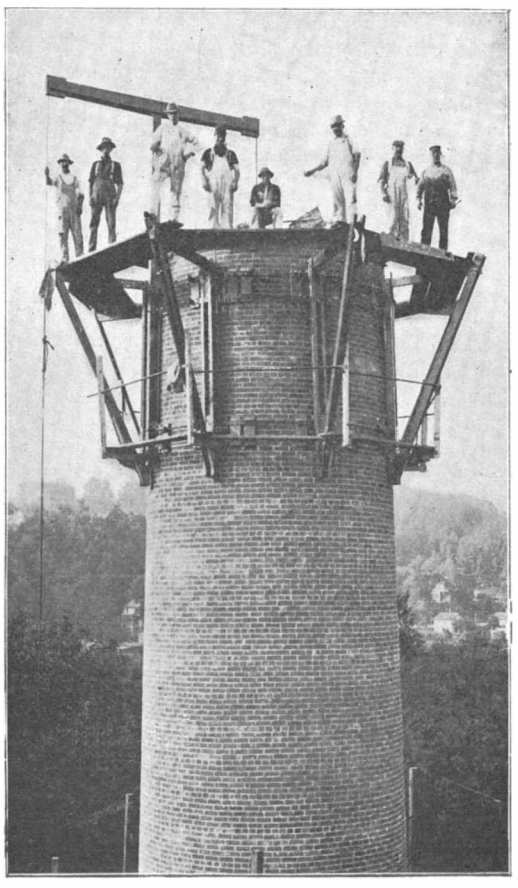


A MACHINE FOR MAKING BRASSES AND BEARINGS.

few inches above the upper band. On these eight brackets rest the planks of the staging proper. The bands are raised and lowered by means of eight screws, one in each section; each screw is 9 feet long and is fastened at the upper band by a collar held between two pieces of angle iron which are bolted to the upright of the bracket. At the lower band the screw, which is threaded 6 feet of its length, passes through a nut held between two other pieces of angle iron which are bolted to the flat iron pieces in that band. The upper band is tightened around the chimney by means of the bolts; the lower band is then loosened by the same means and the screws turn the nuts at the lower band and press against the top pieces of angle iron and raise the lower band to the desired position. That band in turn is then tightened and the upper one is loosened and the screw is reversed, causing the nuts to press against the lower pieces of angle iron, thereby raising the upper band, to which the brackets and staging are fastened, to its proper position, which is about 6 feet above the lower band. This band is then tightened, and the staging is then ready for use.

Our engraving also shows the neat device by which material is hoisted. The crane arm is bolted to one of the sections in the upper band. The workmen obtain access to the staging by means of an iron ladder which is built into the chimney as the work proceeds.

Mr. James Smith, the well-known steeplejack of Rochdale, near Manchester, England, a description of whose *modus operandi* for the felling of tall chimneys by underpinning was published in the SCIENTIFIC



A NEW STAGING FOR BUILDING CHIMNEYS.

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AMERICAN a few weeks ago, recently completed the restoration of a chimney at Bolton, which is second in height to the famous Townsend stack at Glasgow, the tallest chimney in the world. This chimney was erected in 1843, but a few years elapsed before it was extended to its present height.

It is a massive substantial octagonal structure 367½ feet in height, with a circumference of 127½ feet at the base, and 34 feet at the top. About 1,000,000 bricks and 120 tons of stone were employed in its erection. The reason for the chimney being of such extreme height is due to its connection with a large chemical manufactory, since it was found necessary to dissipate the noxious chemical fumes into the atmosphere at a high altitude so as not to cause any inconvenience to the densely populated district below.

From the date of its erection the chimney had undergone no repairs whatever beyond the slight extension, which is a sufficient testimony of the substantial nature of the structure. Generally speaking, from twenty to thirty years is the average life of a chimney before it requires renovation. The hot air and gases that pass upward through the shaft, and the elements, play havoc with the masonry, and if the internal heat is very great, the stack will bulge at the weakest points, so that the work of repair has to be carried out with skill and care.

The overhauling of this chimney presented many difficulties that are not generally encountered in the repairing of chimneys. There was its great height, and also its shaky condition near the summit, to be considered. Under normal conditions, it would have been possible to have inclosed the shaft in scaffolding from top to bottom, but in this instance the erection of such an immense staging would have occupied several weeks. It was therefore decided by the steeplejack to carry out the work from the top, which, by the way, is his general method of procedure, since it is more convenient, more expeditious, and cheaper than the customary method. To accomplish this the stack was laddered from the bottom to the top, with a series of ladders each about ten feet in length, of the minimum weight consistent with the maximum strength. This part of the work is carried out with astonishing celerity. An iron dog is driven firmly into the masonry at the base of the chimney, and the lower end of the first ladder firmly lashed thereto. The steeplejack then climbs this ladder and drives another iron dog into the masonry, to which he attaches the top of the ladder; this dog also constituting the support for the lower end of the second ladder, which in turn is climbed, and the process repeated until the summit is gained. A platform was then built round the top of the chimney, from which all operations were conducted.

Upon close examination the stack proved far more decayed than it appeared to be from the ground below. From a point a little above halfway a wide crack extended to the top of the structure, while much of the masonry in the upper portion was in a crumbling condition. It also appeared that at some time the structure had been struck by lightning.

The only possible repair to the upper portion of the stack was by belting. Successive stagings were erected below the uppermost platform from which to carry out this work. At the corners of the building large heavy iron flanges were let deeply into the masonry and secured in Portland cement. These flanges were then connected by heavy iron tie-rods, by screwing up the nuts of which the brick work was drawn closely together and further opening of the cracks prevented.

When the topmost platforms were erected it was found impossible to haul up the materials from the ground to such an altitude at one lift, owing to the action of the wind on the line and its loads. Three other temporary platforms were therefore constructed nearly half way up, to which the materials were first conveyed, and thence hauled to the upper platforms.

The crack in the side of the stack was successfully repaired by the men working from seatboards suspended from the platform above. In addition to repairing all the defects in the crumbling masonry, and installing lightning conductors, the shaft was repointed from top to bottom, and subsequently two or three coats of linseed oil were applied to the whole structure as a temporary protection against the weather. The work of restoration occupied no less than eight months, and the task constituted the record contract for chimney repairing ever placed in Great Britain.

The Water Supply of Lake Nicaragua.

We are in receipt of an article by Prof. Angelo Heilprin, in which he replies to criticisms by the Hydrographer of the Nicaragua Canal Commission. As limitations of space prevent its insertion in the present issue of the SCIENTIFIC AMERICAN, it will be found in full in the current SUPPLEMENT. The subject of the Nicaragua Canal water supply is one of the most live questions in connection with that stupendous project, and Prof. Heilprin's article will be found to possess timely and very real interest.

A LARGE LATHE FOR TURNING GRANITE COLUMNS.

The new Cathedral of St. John the Divine, which is slowly rising on the site at the south of Morningside Park, bids fair to be many decades in building; and as it is one of the largest structures begun in the century just concluded, it naturally offers many engineering problems of great interest. The quarrying, turning, transportation and erection of the thirty-two granite columns of the choir presented many difficulties, as each weighs two-thirds as much as the obelisk in Central Park, usually known as "Cleopatra's Needle," and the successful solution of the questions involved may be regarded as a remarkable feat of engineering.

The choir, which is eastward of the great arch which is now such a prominent landmark in upper New York, has been built up from the footings to the height of the main floor. The eastern end of the choir is a semicircle, and on the massive foundations will rest great monolithic columns, 54 feet high and 6 feet in diameter, each weighing 160 tons. The blanks from which the columns are turned are quarried by the Bodwell Granite Company, Vinalhaven, Me. The blank shown in our engraving measured 64 feet in length and was 8 feet 6 inches in thickness one way by 7 feet the other, and weighed 310 tons. To turn an enormous mass like this required the construction of a lathe of vast proportions. It was designed and patented by E. R. Cheney and H. A. Spiller, of Boston, and was built by the Philadelphia Roll and Machine Company, of Philadelphia, Pa.

The lathe is 86 feet long, weighs 135 tons and swings 6 feet 6 inches by 60 feet long. Eight tools are used, each taking a 3-inch cut, so that the column is reduced 2 feet each time the cutters traverse the entire length of the bed. The head and tail stocks are carried on extensions of the bed, and the latter is made in six pieces, fastened together by stay-bolts. The entire length of the bed is 86 feet. The head and tail stocks weigh 15 and 14 tons respectively, and are securely bolted to the extensions of the bed. The hollow spindles each weigh 9 tons, and are made of cast open hearth steel. They run in Babbitt metal bearings. The main bearing is of ball design, 30 inches in diameter, and the bearing surface is 30 inches long. There is another bearing 20 inches long at the small end of the spindle; this construction is to obviate the tendency of any thrust on the head and tail stock. The latter is driven by back gears for cutting and is direct driven for the polishing speed. Pulleys 30 and 36 inches in diameter are used and are belted in the usual manner from a countershaft.

The platens which carry the cutting tools rest on friction rollers which raise them just off the bed. The two feed screws, one on each side, are 4 inches in diameter and are 66 feet 3½ inches long, 58 feet 6 inches being threaded. On the platen which carries the tool posts is secured a revolving table which is fitted on its upper side with slots which carry the lengthwise slide, this being operated by a feed screw and has a traverse of 18 inches. To each of the four slides are secured two tool-posts, each provided with feed screws operating at right angles to the feed screw of the lengthwise slide, so that each tool-post is independent and can be used or not as desired. The bearings of the tool-posts permit of a horizontal rotary movement, bolts controlling the angle of the tool. The latter, which is a circular disk of steel 10 inches in diameter and ⅞ of an inch thick, with a V-shaped edge for cutting, is wedged on a mandrel which is in turn held in a sleeve in the tool-post, bolts securing the rear end of the mandrel in position.

Head and tail chucks made of open hearth steel hold the blank in position until it becomes a finished column. They each weigh about 16 tons. Twenty-four set-screws serve to hold the blank, and the entire weight of the great mass of moving stone is entirely supported by these chucks; blocks of irregular shape can be readily adjusted to position.

The corners are roughly dressed off by hand, and the stone begins its six weeks of dressing and polishing. As the stone revolves, it imparts a rotary motion to the cutting disks or tools. The cut is really a splintering of the stone, and three inches of the granite are removed at each cut. After the column is shaped it is polished with hardened steel shot, held in position by a kind of cup carried in the tool-holder. The final polishing is done with the aid of emery and water. When cutting, one and three-quarter revolutions are made a minute, and when polishing, three revolutions. The lathe is driven by a 50 horse power engine, and, notwithstanding the great weight and friction of the moving parts, the lathe runs for about fifteen seconds after the belt is thrown off the pulley.

THE British Postal Department Commission, which has been inquiring into the subject of wireless telegraphy for several months, will shortly report in favor of the earliest possible adoption of the Marconi system. The Commission is also arranging for the purchase of Marconi patents, and is negotiating with France and Germany relative to their attitudes toward the Marconi inventions.

Automobile News.

Consul-General Wildman states that Hong Kong is no place for motor carriages. There are only three carriages of any kind in the entire city.

The motor car is evidently destined to attain popular favor as a public vehicle in England. Wagonettes have been plying for public hire for some time past at Bournemouth, a popular seaside resort on the South coast. One car has been in service for 304 days, during which time it has only been withdrawn for five days; has conveyed 53,806 passengers, and traveled 22,009 miles. It earned $3,225, and the cost of repairs during that period only amounted to $145. The car has never occasioned any trouble, and the petrol motor with which it is provided has been found to be absolutely reliable.

A simple method of recording the speed of motor cars and other vehicles has been devised by M. L. Gaumont, and accounts of the device appear in Cosmos, and La Nature of November 3. The instrument consists simply of a camera with a double shutter, by which two exposures are made of the same plate, separated by a known interval of time. On developing the photographs, two images are obtained of the moving object, and by measuring the distance between them, the dimensions of the car being supposed known, and also measured on the plate, it is easy to calculate the speed of the car at the instant when the photograph was taken. The object is to assist the authorities in regulating the speed of these vehicles and checking furious driving.

Prof. Hele Shaw recently delivered an interesting lecture before the London Society of Arts upon the subject of the Improvement of Road Locomotion. In England, he stated, there had been a remarkable revival of interest regarding the question of the roads of Great Britain, their improvement, and the improvement of means of communication over them. The chief point to be noted in this direction was that while a few experiments had been made upon separate wheels, drawn by mechanical means, the bulk of the observations made by Gen. Morin and by other investigators of the subject were effected by employing the tractive agency of the horse; and with the exception of a few of the experiments with traction engines, the muscular effort of animals had hitherto been the sole means of investigating road resistance. The increased speeds for light and heavy traffic rendered observations of resistance at lower speeds of little use, when they came to the subject of self-propelled vehicles. Motors for such vehicles had now been constructed with a power of as much as fifty horses, but there were strict limitations to the possible power of such motors, and it was important that knowledge should be available in what was comparatively a new subject, as to the conditions by which the greatest economy might be effected. M. Forestier had given instances of the running of heavy motor vehicles in connection with the "Poids Lourds" service in the Department de la Meuse, in which the wear of the roads had been largely increased—in one case, for instance, a wear of 163 cubic yards per year per mile, which involved an increased cost of $200 per mile, while in another it had been necessary to spend $400 per mile in widening and drainage, and to increase the annual expenses in repair by $140 per mile. At the last meeting of the British Association he had obtained the appointment of a committee to investigate the different causes of resistance for self-controlled vehicles on the common roads. Experiments had already been carried out at Liverpool with motor cars over macadam, stone sets, wood pavement, and asphalt. In the three matters of the regulation of speed, uniformity of tractive effort, and ability to maintain considerable speed, a few days' experiments sufficed to show that it was possible to secure accurate and scientific results. As to the effect of the vehicle upon the road surface, it was important to ascertain by experiment the best form of wheels, dimensions of the tire, the effect of the coning and canting of wheels, and of the results from loads of varying magnitude upon roads in all states and conditions. In the course of the discussion which followed, Col. R. E. Compton, who went through the South African campaign, stated that he was profoundly impressed by the alteration of the surface made by the wheels of the traction engines employed by the military in wet weather. The width and diameter of the wheel for conveyance of certain weights required careful consideration. To emphasize the fact that the design of the wheel was most important he observed that in South Africa they introduced a very broad wheel at the outset—absolutely contrary to the time-honored practice of the Boers, who used narrow wheels—and the result had been that the British had been enabled to transport enormous loads, day after day for months together, without hurting the surface; whereas two or three passages of the Boers' narrow wheels destroyed the surface to such an extent that the British could not afterward use the same route.

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Science Notes.

Mr. Evelyn B. Baldwin has purchased the Dundee steam whaler "Esquimaux," of 466 tons, for use in his Arctic expedition.

A recent storm which passed over the south of England overthrew an upright and a cross-piece of one of the great trilithons at Stonehenge, on Salisbury Plain, and the cross-piece of this wonderful supposed Druidical monument was broken by the fall. In 1897 other stones fell.

While engaged in fishing off Lowestoft recently, a fisherman landed in his net a unique piece of amber. It resembled a huge pebble, was oblong in shape, weighed 11 pounds 14 ounces, and is the finest specimen of amber that has been discovered on the English coast for several years. It realized $137.50.

King Alexander, of Servia, has tried to have his life insured for $2,000,000 in several companies, but one company to whom he applied for $300,000 worth of insurance refused to write a policy on the ground of the great frequency of anarchist crimes, and this company had a $600,000 payment to make on the assassination of King Humbert.

The British government encourages inventors and scientists by extending financial assistance to those whose work is considered of sufficient value to warrant such development. The grants are made through the British Royal Society, and range in value from $50 to $2,500, according to the nature of the invention to be exploited. At the present time the Society has in hand $20,000 ready for distribution within the month of January.

The engineers of the cableship engaged in repairing the cable from Galveston to the Mexican coast found that the cable was destroyed by a submarine earthquake, and the catastrophe at Galveston may have been due to the same cause. The destruction of deep-sea cables by earthquakes is so common that it attracts little attention nowadays. In the East Indian archipelago submarine earthquakes are so common that they are reckoned among the chief causes of the destruction of cables.

The work of excavating the Roman remains at Silchester, in Hampshire (England), has been suspended for the present year. It is stated that the work during the past season has been productive of valuable results. A number of tesselated floors have been unearthed, while a magnificent section of mosaic pavement, with a figure representing a dolphin, in a remarkable state of preservation, and over one thousand pots and vessels, of varying sizes and shapes, have been brought to light.

Some interesting and valuable additions have recently been made to the British Zoological Gardens. One is a lizard possessing two tails. As is well known, the lizard avoids capture by leaving its tail in the hands of its captor, the caudal appendage ultimately growing again. In this instance it appears that the tail of the lizard became damaged by some means, but was not detached. A second extremity protruded from the wound, which healed, so that now the lizard possesses two tails. Another unique addition is the three-striped California tree boa. This is the first specimen of this reptile that has come into the hands of the Zoological Society, while the British Museum does not even possess an example of the species. The largest white wolf in captivity also arrived at the Gardens a few weeks ago. A small colony of the tree frogs of Cape Colony has been introduced, representing a variety of colors coinciding with the hues of the particular trees which they infest.

At the Zoological Society of London, Mr. Nelson Annandale, who accompanied the Malay Expedition of 1899-1900, recently delivered a lecture regarding the insects discovered during their investigations. He described the remarkable likeness of some of the Mantidæ to the orchid flower, and it was impossible to discern in the photographs shown the insects from the flower. Mr. Annandale also stated that from prolonged examinations of the lantern-fly, he had discovered that the projection in front of the head was in reality a leaping organ. He followed the movements of one of these insects on the bark of a durian tree. He attempted to catch it, but the insect remained almost still, and drew its legs toward its body and pressed its claws firmly against the bark. It then raised its head with great rapidity, and flew up into the air without spreading its wings, alighting on the roof of a native house about six feet distant. While in Malay, Mr. Annandale was unable to explain this extraordinary movement, but when he reached London and examined his spirit specimens, he discovered that across the nose there was a crease, and when the nose was bent back to the dorsal surface of the abdomen, held between the finger and thumb, and then suddenly released, the insect was propelled through the air for a considerable distance, in the same manner that a pellet may be projected through the air by means of a bent piece of whalebone.

Engineering Notes.

A firm of Hanau, Germany, has succeeded in welding aluminium without the use of any metal, solder or acid. No seam can be detected, and the welded pieces can resist blows and temperature variations as well as if there were no joint. The process is a secret one.

Some estimation of the disorganized and miserable state of the Belgian government railways may be gathered from the fact that recently, while a train was traveling at a moderate speed, one of the carriages dropped to pieces. The passengers were shaken up, and one man had both his legs cut off.

In thirty years the Calumet and Hecla Mining Company paid dividends amounting to $70,000,000, and its corporate existence will expire April 21, 1901, and by that time $4,000,000 more will be added, making the largest sum ever paid in dividends by any mine in the world. Articles of association for the renewal of the corporation have been filed.

Experiments are being carried out in the Austrian army with a new portable oven for field and transport purposes. The oven at present in use is a very unwieldy and heavy article, and has to be transported in sections. The new oven, however, may be carried intact upon a cart, and if necessary, can be utilized for baking purposes while on the march.

Work is to be resumed upon the construction of the Cape to Cairo railroad. It has now been decided to deviate from the route originally surveyed by traveling via Wanki. This decision has been made in view of the fact that the bridging of the Zambesi River will be much facilitated at this point, and also that rich coal fields have been discovered in the vicinity of Wanki. Wanki lies about two hundred miles distant from Buluwayo in a north-westerly direction. The coal is stated to be of great calorific value, and mines are to be sunk immediately.

The British consul at Vera Cruz has recently dispatched to the British Foreign Office an interesting report regarding the state of the trade of that port, and its prospective development when the present extensive harbor works at Coatzacoalcos on the Mexican Gulf, and Salina Cruz on the Pacific, have been completed, and the Tehuantepec railway connecting the two ports, which is at present in such a wretched condition, is reconstructed. Coatzacoalcos possesses a magnificent natural harbor, but its utility is somewhat nullified by the sand bar at the estuary of the river, which considerably impedes navigation. Salina Cruz possesses a fine roadstead, but it is not sufficiently protected from the open sea. It was, therefore, decided some time ago to improve the harbor accommodation of these two ports, and to improve the railway over the Isthmus of Tehuantepec. The Mexican government entered into a fifty years' partnership with Messrs. S. Pearson & Son, Ltd., the well-known contractors, of London, for the construction of harbor works at the two ports and the reorganization of the railway at an estimated cost of about $15,000,000. The work is now in full swing, but progress has been considerably retarded by the effects of the pestilential diseases indigenous to the unhealthy climate and the swampy nature of the district. Yellow fever has played havoc with the engineers, though the health of the district has been appreciably improved by the installation of a thorough sanitary system. The bar at the entrance to Coatzacoalcos is being cleared by the erection of retaining walls, which, when completed, will give a depth of 34 feet of water on the bar, while wharves are to be provided along the river's banks with a depth of 30 feet of water alongside. At Salina Cruz an immense breakwater is being erected to inclose the harbor, which will have a depth of 30 feet of water. The reorganization of the railway will be a very protracted task, since it will have to be reconstructed almost throughout. It is 200 miles in length, and there are no less than 845 bridges and culverts crossed, all of which, with the exception of 12, will have to be rebuilt, since they are at present temporary structures of wood. At places the line, which is very circuitous, will be diverted and shortened, the stiff gradients moderated and curves improved. It is anticipated that three years will elapse before the railroad is overhauled and the harbor works advanced to a stage sufficient to enable steamers to discharge and to embark their cargoes. It is intended to transfer the freight from the steamers from one port to vessels in the other by means of the railroad in less than twenty-four hours, and the tariff will not exceed $4 per ton. When this Mexican route is in full operation, it will afford facilities for the quicker transit of freight between Europe and the Northern Pacific coast, Japan, China, and Australia. It will also compete seriously with the inter-traffic of the Mississippi Valley, since San Francisco is 100 miles nearer to Coatzacoalcos, via Salina Cruz, than New Orleans, from which city it is at present served by the Southern Pacific Railway. The Tehuantepec inter-ocean route is destined to become one of the most important thoroughfares of the world.

Electrical Notes.

The city of Worcester is suing the street railway company in that city in order to compel them to issue three-cent fare tickets to school children, as provided in a recent act of the Legislature.

Open cars will be run all winter by the Union Traction Company, of Philadelphia, with no restrictions as to smoking. The open cars will be run one in five. Open cars are also being operated at intervals on various lines of the Metropolitan Street Railway Company of New York city.

A feature of the Republican parade at Cleveland, November 3, was two old horse cars, which were resurrected for the occasion. The signs upon them said, "Style of 1860. Think and Thank." Notices were given by the daily press that no fares would be collected on the cars and that the public was invited to have an "old time ride."

A message has been sent from the Channel steamer, the "Princess Clementine," to the wireless station at Dovercourt, Essex, by the Marconi system, a distance of 90 miles, including many miles of cliffs. The Belgian authorities are so pleased with the results obtained by the wireless telegraphic system that it will shortly be put on other vessels of the fleet.

The premises 5 West 22d St., New York city, which were formerly occupied by Prof. S. F. B. Morse, were torn down for the erection of a business building. It is gratifying to know that Mr. McCutcheon has had the tablet which used to mark the house replaced. It reads: "In this house S. F. B. Morse lived for many years, and died." Under this has been added, "This tablet removed from building formerly on this site and replaced A. D. 1900."

Experiments with the Marconi system of wireless telegraphy have been resumed on the Ostend-Dover mail boat; and while the steamer was making her way to Dover, in the teeth of a gale, communication was carried on satisfactorily, and messages were transmitted as usual. Messages were sent to and fro at the rate of twenty words a minute until Dover was reached, 61 miles from the mast at La Panne, between Ostend and Dunkerque.

The third cable has been laid between the Netherlands and England. It comprises four wires which extend from London to Rotterdam and Amsterdam. Telegraphing over these wires will be done by means of the Hughes apparatus, and at busy times with duplex Hughes apparatus. The cost of the construction of the cable will be borne by both countries. This will greatly accelerate telegraphic traffic between the Netherlands and England.

The first accident upon the new electric railway in London occurred a short time ago. A motor attached to one of the trains broke down, and all efforts to restart it were unavailing. Under the circumstances it was necessary for men to remove the motor and the current was interrupted. Some of the trains had stopped at the stations when the current was cut off, so that it was possible for the passengers to alight. The latter were not kept in darkness, since the circuit for lighting the arc lamps at the stations is an independent one. Other trains, however, were brought to a standstill in the tunnels between the stations.

The preliminary experiments with the Marconi wireless telegraph installation across the Bristol Channel, between Ilfracombe and the Mumbles Lighthouse, which was erected to the order of the British government, have resulted in complete satisfaction. The distance over which the messages are transmitted is 25 miles. The Ilfracombe station is situated upon an eminence known as Compass Hill. The mast for carrying the high wire is 116 feet in length and is built in three sections spliced together. It measures about 4 feet 6 inches in circumference at the base, tapering to about 10½ inches at the summit, and weighs nearly two tons. The pole is also provided with a yard-arm upon which a portion of the apparatus is suspended. In the trials the messages were recorded upon the tape machines with unfailing regularity and accuracy, even when the high wires were suspended considerably below their full height.

The value of the collections in the "gold room" of the Metropolitan Museum of Art is estimated at $500,000, and they are protected by a most admirable series of burglar alarms. On Sundays and holidays the room is not open, owing to the fact that the large crowd which would attend would prevent the seizing of vandals or thieves. The visitors are carefully watched, and if anyone acts suspiciously, he is followed until he has left the building. The rooms are constantly patroled both day and night. The entrance to the gold room is guarded by two men, and each individual object which is valuable is connected with a burglar alarm, as well as the cases themselves. The wires run direct to the office of the Director, and if any article is disturbed, the iron doors of the room are at once closed, thus catching the thief in a trap. The device is tested at intervals to make sure that the door-closing mechanism is in perfect order.

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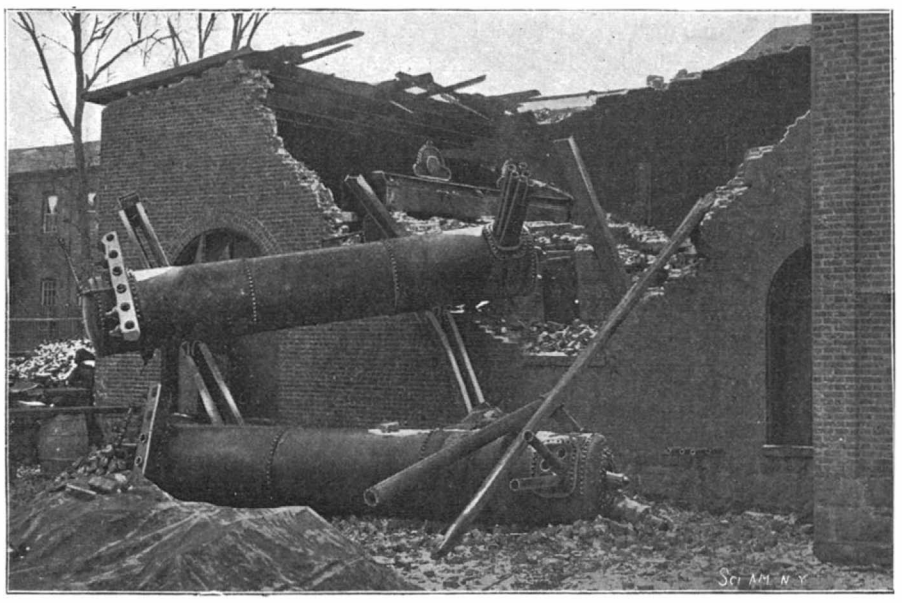
CURIOUS EFFECTS OF BOILER EXPLOSIONS.

BY D. A. WILLEY.

The recent disastrous explosion in New York may always remain a mystery, as far as its cause is concerned; indeed, it is an interesting fact that many of the worst accidents of this kind have been due to causes which could never be discovered. Not only is this true where explosions from combinations of chemicals occur, but where steam or some other motive power is used to operate machinery.

Engineers say that steam boilers cause more mysterious explosions than gunpowder, dynamite or any other explosive. Many cases are on record where the engineer has left the boiler filled to the proper point with water, the fires in perfect condition and apparently every portion of the machinery in good working order; yet, in a few minutes, an explosion has occurred which has blown the building to pieces, possibly killed several persons, and done much damage to property. An investigation fails to reveal any reason whatever for the accident. It is a noticeable fact that engineers are very superstitious and perhaps these explosions without apparent cause make them so. Even a slight accident to an engine frequently causes it to become "hoodooed," or to be considered as unlucky in the eyes of engineers or firemen; and not unfrequently they give up caring for it and get another position. As shown by the accompanying illustrations, some very curious results have resulted from boiler explosions. One of the most remarkable occurred at the works of the National Oil Company at Piqua, Ohio. The works were located on a small creek, running through the center of the city, and in front was a bridge by which many of the employes reached their homes. The engine house was located directly in front of the large building shown in the illustration, and was separated from it by a heavy brick wall. The explosion reduced the engine house to a mass of brick and kindling wood, and the force of the explosion being chiefly in a vertical direction. The small office building which will be noticed between the mill and a frame storehouse on the left side of the illustration was untouched, but the explosion blew a corner out of the warehouse and most of its contents went into the creek. As will also be seen, a big hole was blown in the bank, and one of the abutments of the bridge was carried away. The side walls of the mill were practically uninjured. Although nearly 100 persons were at work in and around the place at the time, none was killed, and only three were injured.

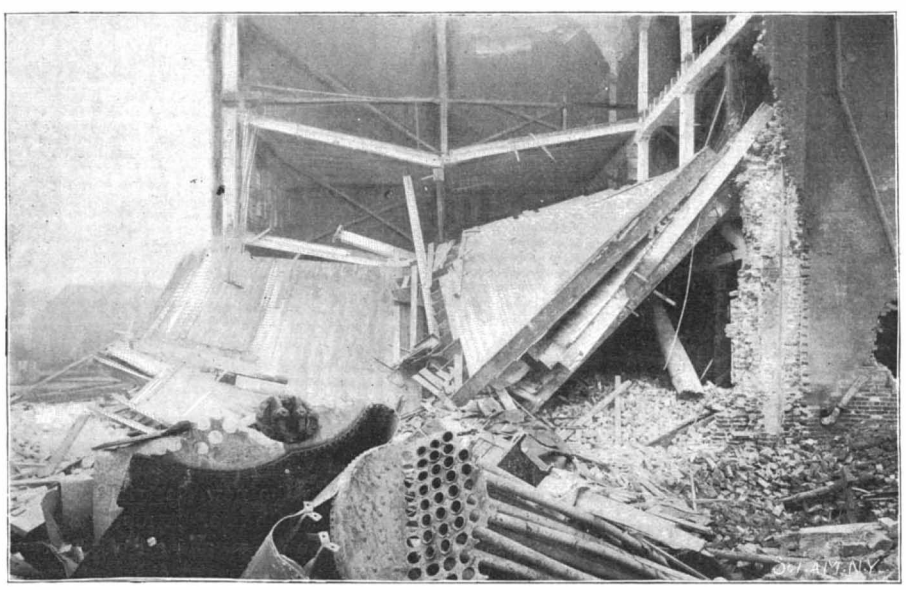


TWO STEAM DRUMS OF A BOILER BLOWN THROUGH BOILER HOUSE.

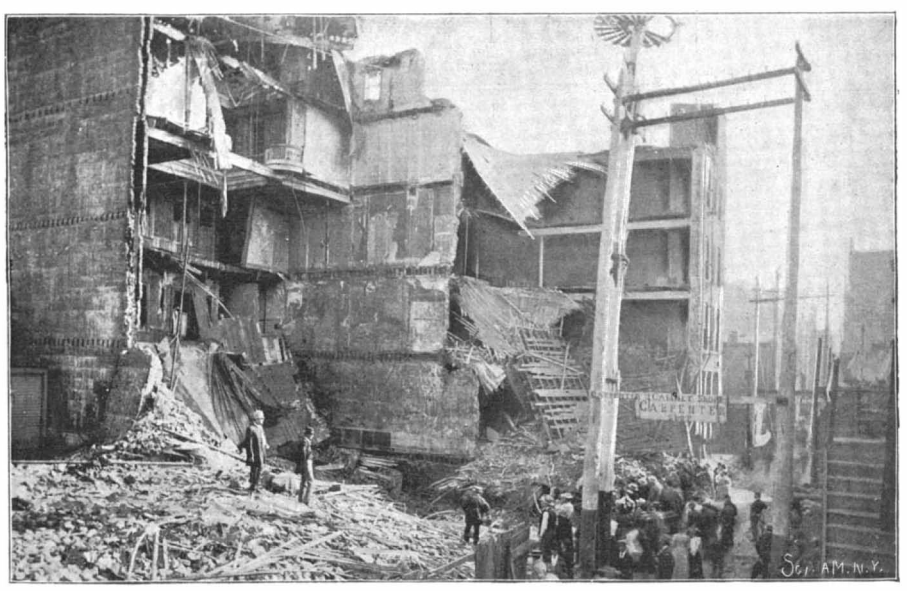
Another illustration shows the wiping out of existence of a harness factory in Massachusetts. Such was the force of the explosion that the entire building was practically leveled to the ground. The location of the engine house can be seen by the mass of twisted boiler tubes which projects in the foreground. The small frame building seen near the boiler tubes was carried to the spot, after the explosion occurred, by the contractor, who secured the work of clearing away the debris. The force of the explosion is seen on the adjoining building, where although the building itself is uninjured, the glass in two of the windows has been entirely blown out, while panes in a large number of others have been shattered. Considering the force of the explosion, experts have considered it strange that the side wall was not blown in.

The accident which wrecked the Gumry Hotel at Denver, Colo., was one of the worst in the history of boiler explosions in the United States. Twenty-two persons were killed and the damage done amounted to nearly $75,000. Although the engine room was located in an extreme corner of the hotel, such was the force that the entire rear portion was blown out. Several of the rooms occupied by guests in this part of the hotel were practically obliterated, as will be seen in the photograph. Some of the rooms were half torn away, leaving exposed the ragged edge of the flooring, with some of the furniture standing intact in the room. A number of the victims lost their lives by being buried under the timber, plaster and brick, which covered the ground in some places to a depth of ten feet.

Without any warning whatever one of the boilers in the engine room of the factory of the Detroit Cabinet Co., at Detroit, Mich., blew out, one afternoon, killing two persons and injuring seven. The force was such that it tore a square corner out of the building almost as perfect in shape as if it had been taken out by a gang of builders. It weakened the flooring supports in the entire building so that they had to be replaced, and twisted the boiler into the peculiar shape shown in the illustration. An idea of the thickness and size of the plates is given, yet they were twisted like so much tinplate. In the case of an explosion at the Peerless Rubber Co.'s works at New Durham, N. J., two steam



EXPLOSION OF BOILER OF DETROIT CABINET COMPANY—SQUARE CORNER TORN OUT OF THE BUILDING.



GUMRY HOTEL EXPLOSION, DENVER, IN WHICH TWENTY-TWO LIVES WERE LOST.

BOILER EXPLOSION AT THE WORKS OF THE NATIONAL OIL COMPANY, PIQUA, OHIO.

COMPLETE DEMOLITION OF A HARNESS FACTORY BY BOILER EXPLOSION—NOTE BROKEN WINDOWS IN ADJOINING BUILDING.

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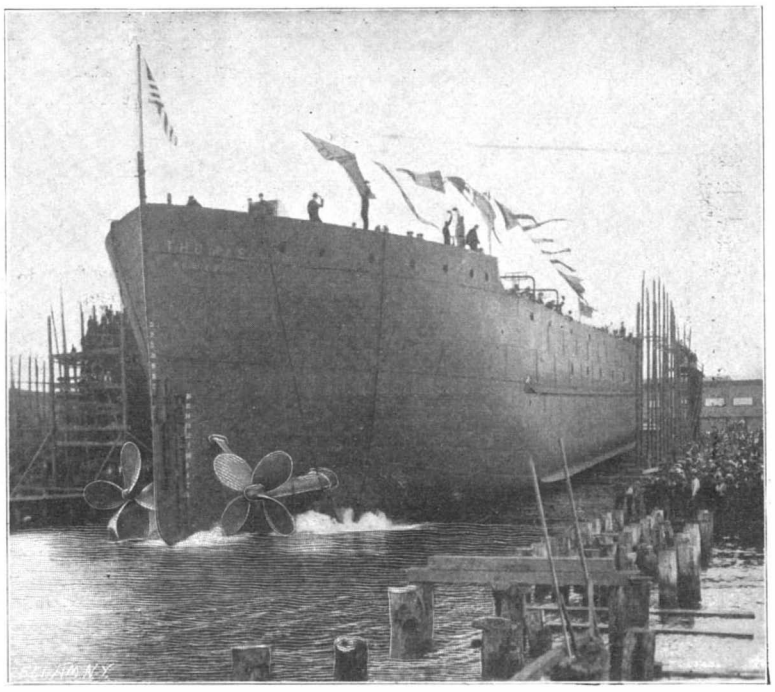
drums of a boiler were blown through the side of the boiler house and landed uninjured on the outside of the building. The accompanying illustrations were prepared from photographs secured through the courtesy of the Hartford Steam Boiler Inspection and Insurance Company, of Hartford, Conn.

DREDGES FOR THE NEW 40-FOOT CHANNELS OF NEW YORK HARBOR.

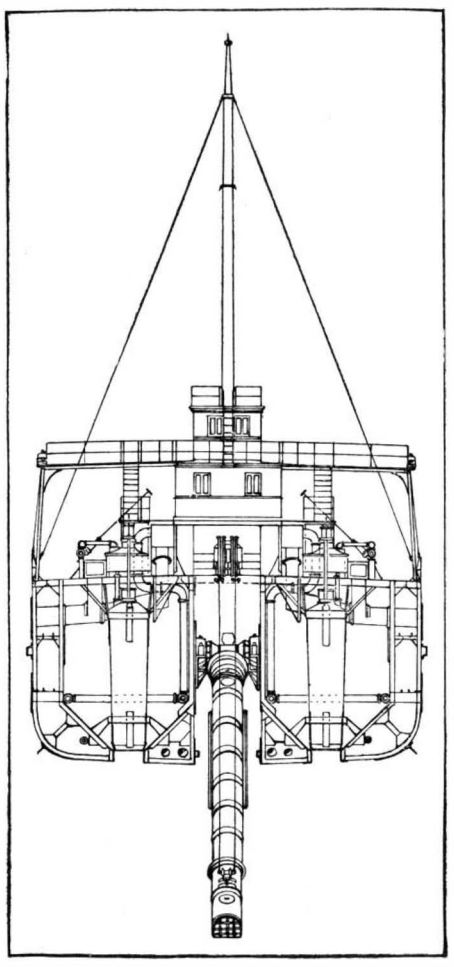
The rapid increase which has taken place of recent years in the size and draught of ocean steamers has necessitated considerable deepening of the channels both in the approach to New York harbor and in the harbor itself. According to statements emanating from the steamship companies in this cty, the largest of the modern freighters have left New York harbor drawing on more than one occasion from 30 to 31 feet of water, and there is now in service one steamship, the "Oceanic," which was designed to draw at full load 35 feet of water, this extreme draught being adopted in the expectation that the New York harbor channels would shortly be deepened.

The scheme of improvement which has received the sanction of Congress contemplates cutting a channel from the 40-foot line, 3 miles outside of Sandy Hook, to a junction with the present main ship channel at a point off the southwesterly end of Coney Island, a distance of 7 miles, and also the dredging of three channels, to be known as Bay Ridge, the Red Hook and the Buttermilk channels, which will extend along the Brooklyn shore from near the northerly entrance to the Narrows to and around Governor's Island until a junction is made with the 40-foot line from the East River to the Hudson River. In the accompanying sketch these new channels are shown in shading. The new channel at the entrance to the harbor will be 40 feet in depth at mean low water and 2,000 feet wide. Bay Ridge, Red Hook and Buttermilk channels are also to be 40 feet deep at mean low water, and each will have a width of 1,200 feet.

The most important waterway, of course, is the entrance channel which will be cut from the 40-foot contour line outside Sandy Hook, across the bar, and will extend in a straight line for 4 miles, to finally swing in to a junction with the deep natural channel through the Narrows. The amount of excavation necessary to complete this great work, which by a recent Act of Congress is to be known as Ambrose Channel, is estimated at 39,020,000 cubic yards, measured in place. The Ambrose Channel will take the place of the present main ship channel, which runs in a general southerly direction from the Narrows to a point opposite Sandy Hook Point, when it takes a sharp turn of over 90 degrees to the east and runs out in a fairly straight line to deep water. This turn has always been a hindrance to navigation, especially since ocean-going steamships have increased to lengths of from 600 to 700 feet. By the Ambrose Channel, as will be seen from the map, shipping can steam from the North River to the deep sea without having to make any turn that necessitates such extreme caution as must be observed in navigating the present waterway. The dredging that is to be done along the Brooklyn shore will necessitate taking out 16,400,000 cubic yards measured in place, and when the work is completed the whole of this important waterfront, with the wharves, elevators, and warehouses, adjacent to these channels will be available, not merely for the largest vessels which are now afloat, but for the largest which are likely to be built for many a decade to come. We illustrate herewith one of the two dredges (the most powerful of their kind in the world) which have been specially constructed for the work of excavating the Ambrose Channel. It will be seen from their dimensions that they are veritabe sea-going steamships. It was necessary to build them of great power and size to enable them to work in the exposed positions in which most of the dredging must be carried on. The first of the two, which has been named the "Thomas," recently came up from the Maryland Steel Company's works at Sparrow Point, Md., where the two dredges have been constructed. They are of what are known as the hydraulic hopper type, and they are the first sea-going dredges to be built in the United States. Preliminary trials of the "Thomas" have been made by the Metropolitan Dredging Company of New York, which has the contract for cutting this channel.



LAUNCH OF THE DREDGE "THOMAS."

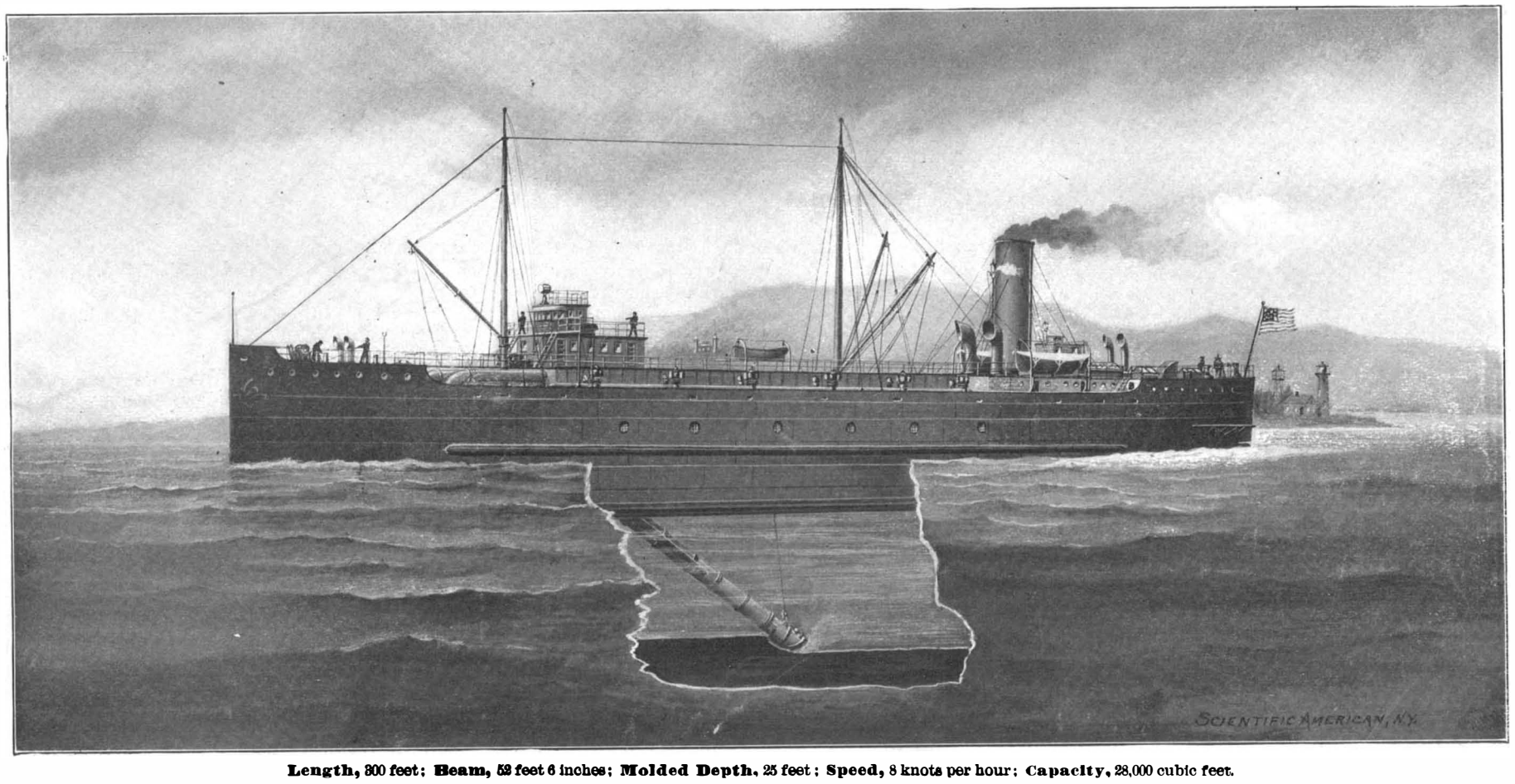


SECTION THROUGH HOPPERS.

In a general way the "Thomas" is modeled on the lines of the "Brancker," the first of two large sea-going dredges which have been doing excellent work in maintaining a proper depth of water in the Mersey, England, but the capacity of the "Thomas" and the sister dredge wil. be some 30 per cent greater than that of the Mersey dredges.

The principal dimensions are as follows: Length, 300 feet; beam, 52 feet 6 inches; molded depth, 25 feet. Outside of the space which is necessary for machinery, bunkers, and the crew, the body of the ship is utilized for holding the material which is sucked up from the bottom of the channel. The quarters for the crew are located forward, while the main engines and boilers are aft. The vessel is propelled by twin-screw, triple-expansion engines, with cylinders 18 inches, 28 inches and 45 inches in diameter by 30 inches stroke, and the estimated speed when she is loaded is 8 knots an hour. Steam is furnished by two Scotch boilers at a working pressure of 180 pounds to the square inch. The body of the vessel is occupied by twelve large receiving hoppers, which are arranged in two lines on each side of the center line of the vessel; eight of these are 20 feet long by 18 feet wide, while four of them are 22½ feet long by the same width. They extend vertically from the bottom of the vessel to the main deck, a distance of approximately 26 feet, and they have a combined capacity of 28,000 cubic feet of material. Each of these hoppers is provided at the bottom with a central discharge valve, opening through the floor of the vessel. The valve is controlled by a hydraulic cylinder, the plunger of which is 12 inches in diameter by 36 inches stroke.

The method of dumping is ingenious and very effective. The discharge opening is circular and about 4



Length, 300 feet; **Beam,** 52 feet 6 inches; **Molded Depth,** 25 feet; **Speed,** 8 knots per hour; **Capacity,** 28,000 cubic feet.

HYDRAULIC SELF-PROPELLED DREDGE "THOMAS," FOR CUTTING NEW 40-FOOT CHANNEL, NEW YORK HARBOR.

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feet in diameter. A circular tube of the same size fits down over the edge of the aperture, and prevents the escape of the sand through the opening during the process of pumping. To discharge the load from the twelve tanks these tubes are all simultaneously lifted by the hydraulic cylinders which are located immediately above them and the sand runs out through the bottom. To facilitate its exit, powerful jets of water are thrown into the mass of sand, a powerful pump being carried on the dredge for this purpose.

Between the hoppers is a rectangular well, in which is hinged a length of suction pipe, 4 ft. 6 in. in diameter. This suction pipe which is hinged by a ball-and-socket joint in trunnions, one in each wall of the well, is raised and lowered by means of 1⅜-inch steel cables, operated by a hydraulic lifting gear. Sand and water are drawn up through the pipe by means of a centrifugal dredging pump of 48-inch suction and delivery. The pump is driven by double, tandem, compound engines, one of which is located on each side of the pump. The engines have 17-inch high-pressure and 30-inch low-pressure cylinders, the common stroke being 36 inches.

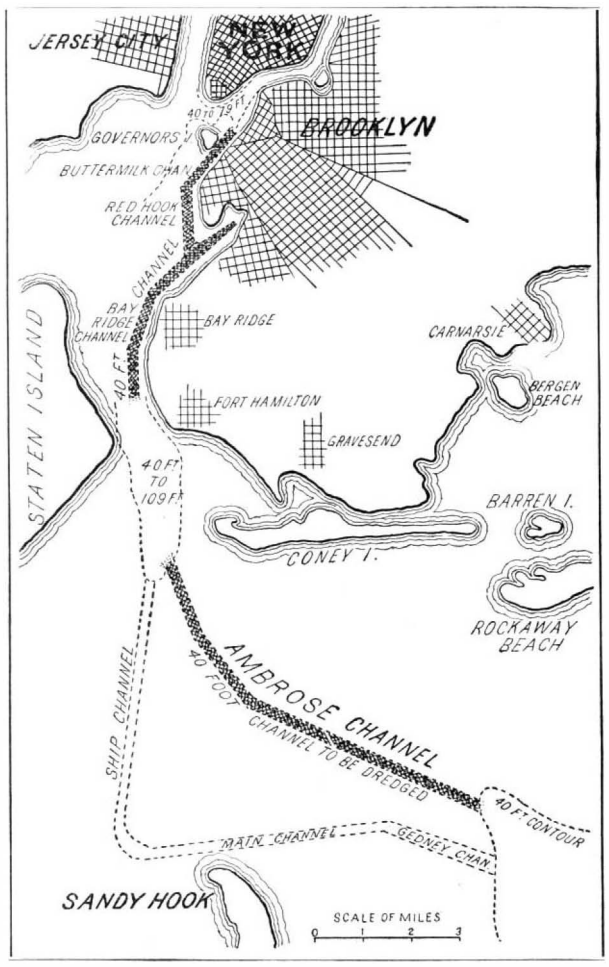
In operating the dredges the sand and water are drawn up through the pump and carried by lines of piping laid along the deck through which it is discharged into the various hoppers, care being taken in loading the hoppers to trim the vessel on an even keel. The sand and mud sink to the bottom of the hopper and the surplus water flows out through the discharge ports in the side of the vessel. When the hoppers are full, the suction pipe is drawn up and the vessel proceeds under her own steam out to sea, where the hydraulic valves are raised allowing the mud, sand, etc., to pass out through the bottom of the hull.

Drainage of Lake Copais.

An interesting piece of engineering work which has been recently carried out in Greece has been the drainage of Lake Copaïs. The lake has practically disappeared, and a large surface of arable land has been thus secured. This sheet of water presented many remarkable features; it was situated near the center of the plain of Bœotia at about 300 feet above the sea level, and was the largest of the lakes of Greece. Toward the north and east it was bordered by high limestone rocks. It received all the waters of Bœotia, the Hereynus, Cephisus and Melas; it was very deep at the foot of the ancient Copæ, but, on the contrary, was partly filled up by alluvium from the slopes of Helicon. At low water it covered a surface of 60 square miles, and its volume reached at times more than 800,000,000 cubic yards, and at some periods its level at the village of Copæ was more than 22 feet above that of the Melas. It had no apparent connection with the sea or with the smaller lakes, the water being carried off by evaporation and by twenty or more subterranean passages which communicated with the canal of Eubœa; these latter were purely natural fissures resulting from earthquakes. The evaporation from the surface was, however, considerable, owing to the high temperature of the region, which in summer reached a mean of 21 deg. to 28 deg. C. and sometimes even 35 deg. When the level of the lake fell at the end of spring a temporary vegetation appeared, which was very abundant, and showed that the soil would be productive if the lake were dried up. Some unsuccessful attempts in this direction were made in ancient times, but it was only in 1880 that the government of Greece made arrangements with a French company, with a capital of $3,000,000, to put into execution the drainage of the lake; for this M. Sauvage had made the projects as far back as 1848. The general plan consisted in making all the waters converge toward the northeast so as to draw them off by a tunnel into the bay of Larymna, but it was also possible to take advantage of the fact that there were two lakes toward the east at a lower level, and it was the latter arrangement which was carried out. It was decided to dig a belt canal around the southern end of the lake which traversed some parts of it and finally ended at the estuary of Karditza; from this point a tunnel took the water to Lake Likeri, the ancient Hylicus, and from there another canal led it to Lake Paralimin, passing by the village of Moriki; a tunnel then brought it to the canal of Eubœa (or Atalanti), near Skroponeri. This work was not, however, finished by the original company; it exhausted its capital, and sold the concession to an English company capitalized at $16,000,000. The company received for the work 16,000 acres of the reclaimed land, and had the use of the rest of the territory, deducting 3,000 acres with which the government indemnified the persons who claimed property rights or possession in certain parts of the lake. The amount of land obtained by the drainage of the lake reaches more than 48,000 acres. The peasants of the surrounding district have already put 15,000 acres in cultivation. The company rents the ground for a payment of 20 per cent of the gross product, at least for certain crops, such as wheat, barley, corn, etc. The cultivator has the right to pasture his stock on the ground reserved for this purpose; he also undergoes a fine if he does not cultivate all the territory he rents. The ground is very fertile, and produces cotton, melons, colza, beet, etc., with success.

Artificial Fossilization of Wood.

M. G. Arth presented to the Académie des Sciences an account of a singular transformation of wood into a substance resembling a fossil combustible. A piece of guaiac wood in a perfectly healthy state had been placed at the bottom of a bronze casting to serve as the pivot of a horizontal turbine of the Jonval type, having a force of 12 horse power and turning at 112 revolutions per minute. The whole of the movable system weighed about 800 pounds; the end of the shaft which rests upon the wood is of steel. Without being immersed in water, the pivot is always damp, as it is placed below the level of the outlet orifices. After six months of running, the apparatus was dismounted. The wood was found perfectly intact in the lower part, but the upper part upon which the steel shaft rested was transformed into a black and brittle substance, breaking easily into small pieces; the brilliant and irregular fractures presented all the appearance of the mineral combustibles. After drying in vacuo, analysis gave 3.9 per cent ash, 4.86 hydrogen, and 69.76 carbon. The organic matter in its original state gave 5.05 hydrogen, 72.59 carbon, and nitrogen and oxygen



MAP OF NEW YORK HARBOR, SHOWING THE NEW 40-FOOT CHANNELS.

22.36 per cent. The relation between the quantity of oxygen and nitrogen and that of hydrogen is 4.42; in woods this relation is about 7; in lignites it is about 5, and in dry coal from 4 to 3. Thus by its composition, as well as by its properties, the black product is to be placed between the lignites proper and coal rich in oxygen; by its calorific power it approaches the latter. It is interesting to remark the short time necessary for this transformation, which was evidently due to the influence of pressure and a moderate elevation of temperature (due to the friction), in presence of moisture; that is to say, under the action of the agents which are commonly made to explain the progressive transformation of wood into ligneous matter and to coal. It is thus shown that under favorable circumstances the time necessary to realize these changes is much less than generally supposed, and the duration of the long geological periods usually considered in such cases is not essential.

Architectural Volumes.

We wish to acquaint our readers with the fact that bound volumes of our Building Edition for 1900 are now ready for delivery. These volumes are invaluable to those wishing to consult plans of houses of a wide range of cost and architecture; numerous perspectives and floor plans are given in each issue. A feature of this edition during 1900 was the numerous cuts of beautifully furnished and decorated interiors.

Correspondence.

The Parsons Steam Turbine.

To the Editor of the Scientific American:

In answer to your kind request that I should contribute an article on Steam Turbines in your valued and influential columns, it has given me much pleasure to compile a short statement of the present state of the steam turbine industry so far as it relates to the Parsons steam turbine, manufactured by the following firms: Messrs. C. A. Parsons & Company, Heaton Works, Newcastle-on-Tyne; the Parsons Marine Steam Turbine Company, Limited, Wallsend-on-Tyne; the Westinghouse Machine Company, of Pittsburg, Pa., U. S. A.; Messrs. Brown, Boveri & Company, of Baden, Switzerland, and a German company now in course of amalgamation.

Messrs. C. A. Parsons commenced the manufacture in the year 1884, and have gradually improved and increased the size of the steam turbines manufactured by them. At the present time the aggregate horse power of turbines at work for electrical purposes exceeds 140,000 horse power. The largest size plants yet constructed are two of 1,000 kilowatts output for the municipality of Elberfeld, in Germany. The consumption of steam of these plants when tested by a deputation of experts from Germany, W. H. Lindley, Prof. Schroter, and Prof. Weber, showed the following results:

"At the overload of 1,200 kilowatts, and with a steam pressure of 130 pounds at the engine, and 10 deg. C. of superheat, the engine driving its own air pumps, the consumption of steam was found to be at the rate of 18.8 pounds per kilowatt hour. To compare this figure with those obtained with ordinary piston engines of the highest recorded efficiencies, and assuming the highest record with which I am acquainted of the ratio of electrical output to the power indicated in the steam engine, namely, 85 per cent, the figure of 18.8 pounds per kilowatt in the turbine plant is equivalent to a consumption of 11.9 pounds per indicated horse power, a result surpassing the records of the best steam engines in the production of electricity from steam under the conditions named."

I have also pleasure in sending you an official translation of the report of these gentlemen.

So early as 1892 the steam consumption of the turbine had been lowered to 27 pounds per kilowatt hour, or 16 pounds per indicated horse power, as testified by Prof. Ewing, F.R.S., of Cambridge, England; and in the following year its application to marine propulsion was undertaken by the second named company above, and led first to the construction of the yacht "Turbinia," of 34½ knots speed, completed in 1896, and later to that of H. M. S. "Cobra," of 400 tons displacement and 35 knots speed, and H. M. S. "Viper," of 370 tons displacement and 36.58 knots mean speed on a one-hour trial under English Admiralty conditions of weights and measurements. During the trials these vessels have shown a coal consumption per indicated horse power within the guarantees, they have suffered no breakdown or hitch directly or indirectly connected with the turbines, during their official trials, and the "Viper" has exceeded her contract speed by more than 5 knots.

On November 1, 1896, the United States and Canadian patents for land purposes only were acquired by the Westinghouse Machine Company, of Pittsburg, but up to the present time I am only aware that five plants of 120 to 300 kilowatts capacity have been put to work, and one of 1,500 kilowatts capacity is under construction. This should be contrasted with English output of over 130,000 horse power during the last ten years for electrical purposes only.

Last August Messrs. Brown, Boveri & Company, of Baden, undertook, in conjunction with ourselves, the manufacture of steam turbines for electrical purposes on the Continent, and they have at present an order for a 4,000 horse power turbo-alternator for Frankfort-on-Main besides quite a number of smaller plants.

I have had my attention directed to an article by Rear Admiral George W. Melville, Engineer-in-Chief of the United States navy, in your issue of November 24, and as I have the honor and pleasure of his acquaintance by correspondence, and know his invariable courtesy, I venture to hope that he will pardon me when I say that the "Viper" and the "Cobra" are not "racing machines," but formidable torpedo-boat destroyers, of the usual scantlings of the English 30-knot destroyers, strengthened specially for the higher rates of speed to which they have attained; that they can outstrip by many knots any other destroyers in the world in smooth or heavy weather, and that their complete absence of vibration at all speeds permits of an accurate sighting of guns and torpedoes, impossible with similar vessels fitted with reciprocating engines.

I may perhaps further explain that though the first marine steam turbines have been fitted in very fast vessels for the obvious reason of facilitating the development of a new system, yet steam turbines are

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quite as readily designed for battleships, cruisers, Atlantic liners, and all fast passenger vessels, and in such vessels will, in my opinion, give results as regards coal consumption at all speeds superior to those at present obtained with reciprocating engines.

As the turbine, when installed on land, as in England and at Elberfeld has surpassed in economy of steam the best triple-expansion reciprocating engines, and the turbine of 4,000 horse power for Frankfort is guaranteed to still further improve the lead; so in marine work the steam turbine is destined to replace the reciprocating engine in all fast vessels from moderate up to the largest tonnage.

CHARLES A. PARSONS.

Turbinia Works, Wallsend-on-Tyne, December 18, 1900.

THREE RECENTLY PATENTED NOVELTIES.

One of the most interesting inventions for which letters patent have been granted within the last few weeks is a process of coating one metal with another, devised by Samuel H. Thurston, of Long Branch, N. J. The metal to be coated (usually iron or steel) is first so thoroughly cleaned that all foreign matter is entirely removed. After this thorough cleansing the metal is ready to receive its covering. The coating metal is systematically beaten against the metal to be coated. This beating process is produced by vibratory beating-rods, pivoted to bars secured on a rapidly revolving drum. The drum is located above a bed plate arranged to move beneath or over the radius of action of the beating-rods. On the bed-plate the metal plate to be coated is firmly secured, so that by rapidly rotating the drum the beating-rods strike the surface of the metal. The particles from the beating-rods are hammered into the pores of the plate, and are incorporated with its surface to form an adherent film of metal. So perfect is the cohesion of the two surfaces that the film can not be mechanically removed without removing particles of the plate.

In order to reduce the friction of worm-gearing, Charles M. Jones, of Philadelphia, Pa., has invented the novel device illustrated in the second of our engravings. The driving or pitch faces of the worm are formed with a continuous groove, which receives a series of balls. During the rotation of the worm the balls travel freely along the usual pitch-line and bear against the teeth of the meshing wheel. Thus Mr. Jones substitutes rolling friction for the usual sliding friction.

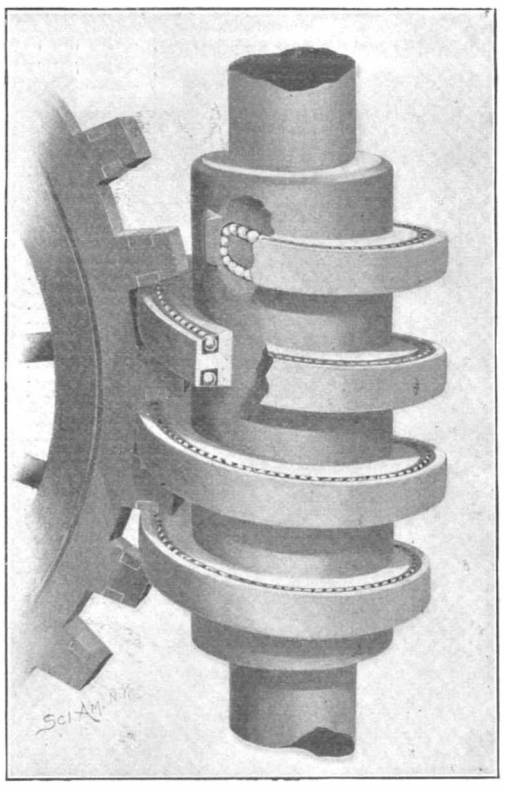

Fig. 2.—A BALL-BEARING WORM GEAR.

An odd little mechanical toy which is noteworthy for its simplicity is the subject of the third illustration. The toy is the invention of John J. Reid, of Lyons, Iowa. Upon an upright having on opposite edges cam-like, staggered fulcrum-bearings a seesaw lever is mounted. The lever is provided with opposite fulcrums in the form of tongues, alternately engaging the bearings. At the ends of the lever figures representing a clown and a negro are pivoted. The seesaw being at the upper end of the standard with the lower fulcrum tongue resting in one of the bearings, the upper end of the longer portion of the seesaw will rock down by reason of its greater weight until its fulcrum tongue engages the next lower bearing and the opposite end of the lever moves downwardly. This alternate rocking motion continues until the seesaw has reached the lower end of the standard The standard is then reversed, and the seesaw retraces its course.

Internal Water-way Improvements About Pittsburg.

The varied manufacturing interests and vast coal trade of Pittsburg are due to cheap water transportation. In 1836 the Monongahela Navigation Company was organized for the purpose of establishing a slack-water system on the Monongahela between Pittsburg and Virginia (now the West Virginia) State line. The company was chartered with a capital of $300,000, held largely by those interested in the industrial rise of Pittsburg and in the development of the rich coal fields along the Monongahela. The work of establishing dams on the stream was begun in 1838. Instead of the shoaly rippling stream which it was before its improvement, the Monongahela is to-day a noble stream whose traffic amounts to many million tons annually. Until 1897 the slack-water system remained in the hands of the private corporation which had begun the improvement of the stream; but in that year the locks passed into the hands of the United States government, and thus a free system of navigation was begun. In early days both the Allegheny and

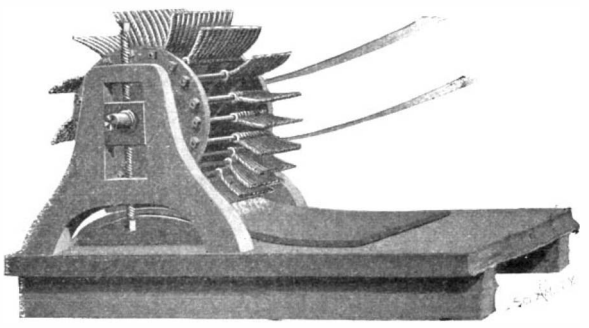

Fig. 1.—THE THURSTON METAL-BEATER.

the Youghiogheny possessed a system of dams, but these were permitted to fall into decay. Of late years several government dams have been constructed on the Ohio, but these are not sufficient to provide the stream with free navigation at all seasons of the year.

The time is not far distant when the rivers adjacent to Pittsburg will have an elaborate slack-water system. Congress has passed bills which provide for six dams on the Ohio, including the Davis Island dam, which was completed in 1885. The new dams, like the Davis Island dam, will be of the movable type, so that they can be lowered at any time, leaving a clear channel. They will be located at Glenfield, Osborn, Legionville, Freedom and Merrill, the dam at the latter point being the lowest one on the Ohio which will be erected at the present time. Surveys have already been made for a government dam at Marietta, Ohio, but the work has not yet been begun. It is believed that the series of dams now under construction can be completed within three years.

The work on the Ohio River dams is now well under way, the locks of all the dams being nearly completed. At Merrill the greater part of the dam is finished. The gate at Merrill will, when completed, be the largest one of the movable type in the world. It is 13 feet high and 112 feet wide. It will be moved by hydraulic power, derived from the river, which it will hold back. All of the Ohio River locks will be of the same type.

The Herrs Island dam, on the Allegheny, is already completed, and will be the only Allegheny River dam of the movable type. The other three dams now under construction will render the Allegheny navigable for large river steamers above Tarentum, a distance of 30 miles above Pittsburg. This river improvement will provide a water outlet for the various important industries located in the Allegheny Valley. The Allegheny locks will be 300 feet in the clear, with a width of 60 feet.

Some day a ship canal will connect the Ohio with the Great Lakes. The preliminary survey for this great waterway improvement was made some years ago, when it was proposed to construct a canal which would give vessels of 3,000 tons or more free passage between Lake Erie and Pittsburg at the expense of Pittsburg capital. A detailed description of this great internal improvement will be found in the issue of September 24, 1898, of the SCIENTIFIC AMERICAN. This great canal will solve the problem of cheap transportation of the ore supply for the Pittsburg furnaces, open up an artery for the vast coal-carrying trade, and enable Pittsburg manufacturers to enter foreign markets.

Favoritism to Workmen.

It often happens in factories, says The Superintendent and Foreman, that one workman has a "pull" with other workmen, and by this means is able to make considerable money at the expense of his fellows on the same branch of work, and this all unknown to the foreman. Sometimes man after man will leave the factory, and if asked the reason for quitting, all that can be gotten from them is an indistinct muttering about not getting a square show, and the foreman wonders wherein he did not give the men a square show, and finally sets the men down for cranks.

The men cannot always say positively that it is so; they feel it rather than see it. They see a workman next to them always having the lasts he needs, or always getting the easiest case to set up, buff, or scour, and yet they are not able to see just how it is done. Not seeing, they do not feel like making definite charges or statements, as they do not know how to sustain them; but they are assured in their own minds, for they have encountered the same thing before, that there is a clique running the factory.

Cliques run a great many factories, and generally without the foreman's knowledge. Sometimes a foreman is partner to a clique, and sometimes he believes it is good policy for the firm; and occasionally it is, but very seldom. The best managed factories have systems which make favoritism of one workman to another impossible.

In some factories the firm has a man whose business it is to hunt up all obstacles to good work, including such as this; and it would be a good thing for many manufacturers to use up any spare time they have in asking the more intelligent of their employes—not always the old help, though—what difficulties they meet with. It is not a bad thing to have your factory have the reputation of being a good one to work in, for the time may come when help will be needed, and when not being able to secure the right help at the right time will cause the loss of considerable money.

The Current Supplement.

The current SUPPLEMENT, No. 1306, is of unusual importance, the leading article being entitled "The Steam Turbine: The Steam Engine of Maximum Simplicity and of Highest Thermal Efficiency." This paper is by Dr. Robert H. Thurston, of Cornell University, and may be regarded as one of the most important contributions ever made to the literature of mechanical engineering. It is elaborately illustrated. "The Pollak-Virág Telegraph" is described in detail, showing the ingenious mechanism by which messages can be transmitted and written at high speeds. "The German Colony of New Guinea" is illustrated by many engravings. "The Mechanism of Amphitheaters" is a most interesting article, showing how the cages containing the animals were lifted to the level of the arena by mechanical means and opened automatically, and how the great awnings were warped across the amphitheater in sections. "A New Method of Testing Glass Surfaces" is by Edmund M. Tydeman.

January Building Edition.

The January issue of the BUILDING EDITION worthily begins the new century, and it is one of the handsomest numbers ever issued of this unique periodical. The

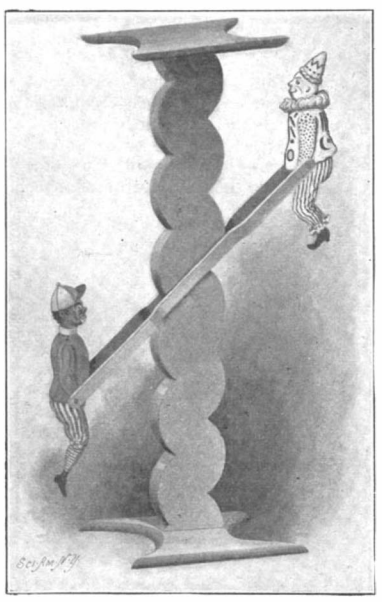

Fig. 3.—AN ODD MECHANICAL TOY.

cover illustrates a half-timbered house at Greenwich, Conn., and is printed in a highly artistic manner. The other houses which are given in this issue are excellent. Among the many interesting features of this edition are the "Spanish National Pavilion at the Paris Exposition," "A Remarkable Wood-Carving," and a "Mediæval German City Gate." The literary contents deal with "Mechanical Triumphs of the Ancient Egyptians," "An Architectural Critic in the Year 2000 A. D.," and "Athens in 1900."

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

HAY OR STRAW STACKER.—ROBERT GRISWOLD, Grover, Colo. This invention relates to portable machines for unloading and stacking loose hay and straw.. A characteristic feature of the invention is a very simple construction of directing platform which, when used in connection with a hoisting rope, guide ropes and a swing, can be conveniently utilized to convey the hay in the form of a roll from a wagon to the ground, where the stack is to be formed.

MACHINE FOR TOPPING BEETS.—JULIUS H. LUHRS, Fruita, Colo. The machine is especially adapted for topping beets in the field, and is designed to be drawn between rows of beets in order that it may operate on the tops of two rows simultaneously. The cutters cleanly sever the tops. The distance between the cutting blades and the ground can be readily regulated. The machine can be raised at the front so as to carry the cutters some distance from the ground in driving to and from the field.

CORN-CUTTER. — CHARLEY O. EBERLEIN, Shawano, Wis. The device comprises a metal foot-plate having downwardly-pressed ribs and an extension-plate formed with a slot. A screw passes through the slot into the foot-plate. The channels formed by the depressed ribs are engaged by downward extensions on the front end of the extension-plate. On the front end of the foot-plate a cutting-blade is carried. The operator grasps the corn-stalks, and, by forcing his foot forward against the cutting-blade, severs the stalks near the ground.

KNIFE FOR HARVESTERS, MOWERS, ETC.—HERSCHEL OLDHAM, Orleans, Ind. Mr. Oldham has invented a novel knife or cutter for harvesters, reapers, mowers, lawn-mowers, and like machines. His invention is an endless or chain-knife, which is inclosed in a casing having upper and lower plates provided with flanges at their front and rear edges. Between these flanges the blades of the endless chain-knife are projected.. A cover is fitted over the rear flanges and the rear run of the knife. The travel of the knife is the same at all points, since there are no centers to pass. Repairs can be easily made.

Electrical Apparatus.

PUSH-BUTTO.. — THOMAS A. NATHANS, Manhattan, New York city. On a bottom plate a casing is removably held; and through the top of the casing a push-button slides. A double contact device is adapted independently to close a normally open circuit when the push-button is depressed, and also when the casing is partially removed from the bottom plate. By reason of this construction the bell can be sounded either in the ordinary manner or when a removal of the parts of the bell is attempted.

CALL-BOX.—EDGAR E. SALISBURY, Chicago, Ill. The object of the invention is to provide a simple mechanism for connection with a telephone system, which may be employed to send a telephone call to the central station or to serve as a messenger call. A telephone cannot be placed in the circuit without first sending a signal; and after one conversation is finished and the receiver replaced, a second conversation cannot be had without repeating a call.

Mechanical Devices.

BARREL MACHINE.—JOHN S. WRIGHT, JR., Churchland, Va. The novel feature of the invention is a form comprising end-rims U-shaped in cross section, and intermediate rims formed with perpendicular annular flanges alternately arranged. Connecting rods are passed through the base of the end rims and through the annular flanges of the intermediate rims. When the rims of the form are made in three segments, as in the present invention, the exertion required for lifting the hinged sections, either in opening or closing the form, is comparatively insignificant when compared with the exertion required for opening and closing one-half the heavy form.

MOTOR TOY.—JOHN H. WHITING, Manhattan, New York city. Mr. Whiting has invented a perambulating toy in the shape of a horse. A motor and lever connections are provided for simultaneously operating the legs of one side in opposite directions, causing the animal to walk. By means of an attachment to the neck the head can be employed for winding the motor-spring.

Railway Appliances.

RAIL-JOINT.—SILAS B. WHARTON, South Bend, Ind. The rail-joint has a sleeve engaging the bases and the webs of the ends of adjacent rails. Bolts extend through the sides of the sleeve and through the rail-webs; and a nut-lock-bar engages the sides of the bolt-nuts. The bar has an extension adapted to extend along the under side of the base of the rails, the extension crossing through the sleeve. A key or wedge securely fastens the nut-lock-bar in position.

Miscellaneous Inventions.

BUDDING IMPLEMENT.—WILLIAM NELSON, Jefferson Parish, La. In the operation of budding it is the usual practice to remove a piece of bark from the tree to be budded, and then to remove a similar piece of bark from the limb of a tree bearing a fine variety of fruit. The piece of bark to be budded on the tree should be of the same size as the piece previously cut from the limb. In carrying out the present invention parallel blades are employed which are operated transversely of the stock to be budded and the tree from which the bud is to be removed. Thus the bud section is made to correspond in size and shape with the space provided for it.

AUTOMATIC VEHICLE HITCH-BRAKE.—CHARLES KITCHEN, Elwood, Ind. The invention provides an attachment for vehicle-brakes so constructed that, when the brake is fully or partially applied at the time a vehicle is to be left standing, the driving-reins may be attached to the brake-lever and the brake-beam be controlled automatically to such an extent that, while the animal is free to move forward or backward a limited distance in the shafts, an undue forward or backward movement will result in the application of the brake shoe or rollers to the wheels of the vehicle. Thus the horse and the wagon must of necessity remain where they have been left standing.

DISK-SUPPORTING ATTACHMENT FOR GRINDSTONES.—WILLIAM W. HEWITT, Gettysburg, S. Dak. The disk-supporting attachment comprises a post for receiving the disk to be sharpened. Inwardly-inclined rollers of different diameters support the disk, and springs coiled around the post hold the disk against the roller. When the device is carried to a grindstone and the grinding-wheel is brought into contact with the disk, the whole arrangement will revolve during the sharpening process.

COMBINATION PIPE, CIGAR HOLDER AND CIGARETTE HOLDER.—PHILIP FISCHER, Plauderville, N. J. This very novel smoker's article comprises a body having members with connected bores of different sizes. One of the bores is designed to receive the stem of a mouthpiece or a cigar and the other bore is arranged to receive the mouthpiece-stem, a cigarette, or the stem of a pipe-bowl. A pipe-bowl has a stem for engaging one of the bores; and a mouthpiece has the end of its stem reduced to fit the smaller bore of the body. The portion of the stem above the reduced end fits the larger bore.

CARTRIDGE. — ANTONY BARRALLON, St. Etienne (Loire), France. The invention provides a cartridge which, on the one hand, insures the indefinite preservation of the powder charge and on the other hand a complete and quick combustion of the charge, together with its casing, as soon as the shot is fired, in order to reduce the work required for firing the gun.

MICROMETER-GAGE.—ALBERT A. BRANDT, Birmingham, England. This new micrometer-gage is arranged to permit a correcting adjustment in case of deviations in the setting of the micrometer device on a beam and to permit convenient adjustment of the micrometer device in case of wear on the anvil and spindle. On the beam a main micrometer device is movable, adapted to be fastened at measured points. The micrometer comprises a barrel in which a cylinder is adjustable. A sleeve is connected with the cylinder and extends over the barrel. A spindle is likewise carried by the cylinder. The sleeve has a graduated end to indicate micrometer adjustment relatively to the barrel, and a correcting micrometer device indicating on the other end of the sleeve to adjust the spindle of the main micrometer device to any discrepancy in the setting of that device on the beam.

PLEASURE-CANAL. — GEORGE W. SCHOFIELD, Coney Island, Brooklyn, N. Y. The inventon is a pleasure device having a large waterway in a comparatievly small space, the banks of the waterway being provided with scenery of an amusing character. A novel means has been devised for shifting the boats from the lower level or terminal of the canal to the higher level or starting point.

Designs.

GEM-SETTING.—GERHARDT G. M. F. ARTMANN, Manhattan, New York city. Mr. Hartmann has received two design patents for settings in which the gems are arranged in the one case in two parallel long side members and two parallel end members, together with chains of bead-like figures appearing within the border. In the second design, within a rectangular border chains of globular and irregular gems are arranged in parallel lines.

LOCK AND HINGE FASTENER FOR BOXES.—GEORGE B. SCHMIDT, Brooklyn, New York city. This novel fastener is formed of a single piece of wire which can be readily applied to a box. The simplicity of the device is its chief merit.

LEATHER FABRIC.—CHARLES D. WILLIAMS, Manhattan, New York city. The leading feature of the design consists in forming on one surface of the fabric closely-arranged, irregular and slight projections to give a stippling appearance. Channels are employed to represent veining.

SHADE-ROLLER BRACKET.—WILLIAM R. MADDERN AND EDWARD H. HIGBEE, JR., St. Louis, Mo. The body of the bracket is essentially rectangular and has at one side a bayonet-slot. Between the slot and the opposite edge of the body are two openings: and from the upper end of the opposite edge a spur projects.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8023) M. J. H. asks: 1. Can the continued use of an electric generator or small dynamo have any ill effect on a person if it is used about three times a week as hard as it can be stood? A. Yes; most certainly. Our advice to all is to use electricity only under the direction of a competent physician. Then there will be no danger of ill effects. 2. How may a piece of gold be dissolved and made into a plating solution to be used with batteries? A. Gold is dissolved in aqua regia. 3. Can any kind of plating solution be made by dissolving the salts of the metal in water or anything they will dissolve in? A. For preparing plating solutions see Watt's "Electroplating," price $1 by mail. 4. Can an alternating current dynamo be changed to a continuous current without altering the dynamo? A. An alternating current dynamo may be converted into a continuous current machine by replacing the collecting rings with a commutator. You can probably make a commutator from the plans in SUPPLEMENT 600, price 10 cents.

(8024) E. A. M. asks: 1. Is there a SUPPLEMENT in which I may find a description of an arc-lamp suitable for lantern use? A. Information on arc electric lights for lanterns will be found in SCIENTIFIC AMERICAN, Nos. 12, vol. 66; 11, vol. 74, and 6, vol. 75; also SUPPLEMENT, Nos. 756 and 956. Price of above, 10 cents each. 2. What would happen if a shunt-wound dynamo were short-circuited across its terminals while running under full load? A. If a shunt-wound dynamo is short-circuited it will develop heat in the circuit very rapidly and burn out the short circuit if possible. If this does not happen it may throw the belt or be stopped by the excessive load thrown upon the armature.

(8025) H. H. asks: Can you answer through your information department, in a general way, the proportion of gas required to run gas engines of 6 H. P., and less alone, bare of any load, to the quantity required to produce the power to run machinery attached to such engines? I have been using a gas engine (4 H. P.) some time to operate printing machinery intermittently, and with varying loads, with very satisfactory results economically and otherwise. But a test shows that it requires as much gas to operate the bare engine as the guaranteed quantity for 1½ H. P. in the machinery. At price of gas here to run the engine continuously would cost $100 a year, if the driving belts were removed and the shafting wholly disconnected, while the additional consumption of gas for small printing machinery, such as platen presses, paper cutters, etc., is almost nothing. That makes this power very economical for short runs, but hugely expensive for continuous work, especially where a single light machine is the chief load required. Can the engine be taking the normal quantity of gas, or is something wrong with the adjustments? Apparently nothing is out of order. If there is an approximate rule governing the amount of gas to drive the engine alone—in proportion to its power—it would aid materially in solving a perplexing problem. A. The best gas engines of 6 H. P. use about 18 cubic feet of illuminating gas per H. P. per hour for full load with gas and air inlet properly adjusted. The gas consumption does not decrease directly with the load. The friction of engine, belting and shafting is a constant quantity that does not vary by the throwing on and off of small machines, but you should have an efficient governor on the gas inlet to save waste.

NEW BOOKS, ETC.

VICTOR VON RICHTER'S TEXT-BOOK OF INORGANIC CHEMISTRY. Edited by Prof. H. Klinger. Translated by Prof. Edgar F. Smith. Fifth American from the tenth German edition. Philadelphia: P. Blakiston's Son & Company. 1900. 8vo. Pp. 430. Price $1.75.

The present edition differs materially from those that have preceded it, and includes the very latest discoveries. The form of presentation is excellent and the subject matter is carefully proportioned. The great and well-deserved reputation of von Richter and also that of the editor and translator is sufficient guarantee of the adequacy and accuracy of the text. It is an admirable text-book and is one of the best chemistries we have seen.

COMMERCIAL ORGANIC ANALYSIS. Vol. III., Part 1. Tannins, Dyes and Coloring Matter, Writing Inks. By Alfred H. Allen, F. I. C., F. C. S. Third edition. Rewritten and enlarged. Revised and edited by J. Merritt Matthews, Pn. D. Philadelphia: P. Blakiston's Sons. 1900. 8vo. Pp. 589. Price $4.50.

This volume is a chemical classic and merits unstinted praise. It deals with the properties, proximate analytical examination and modes of assaying the various organic chemicals and products employed in the arts, manufactures, medicine, etc., with concise method for the detection and determination of their impurities, adulterations and products of decomposition. These remarks apply to the whole series, and the present volume deals with such important subjects as tannins, dyes and coloring matters, also writing inks.

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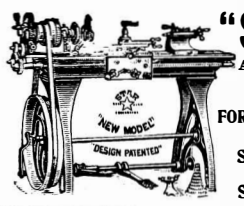

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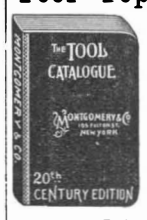

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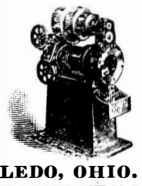
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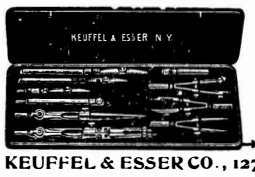

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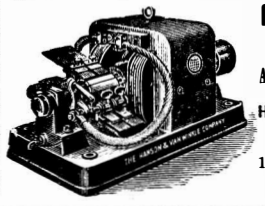
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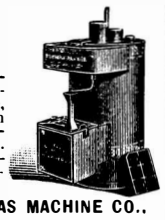
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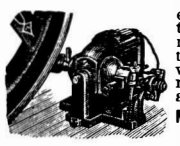
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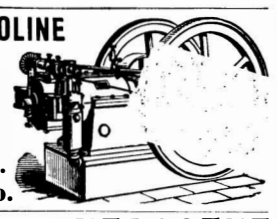
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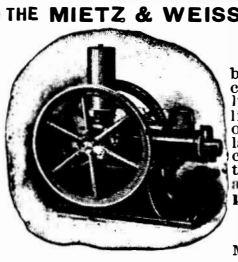
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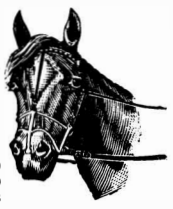
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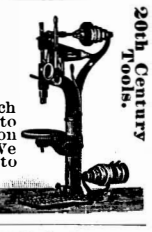

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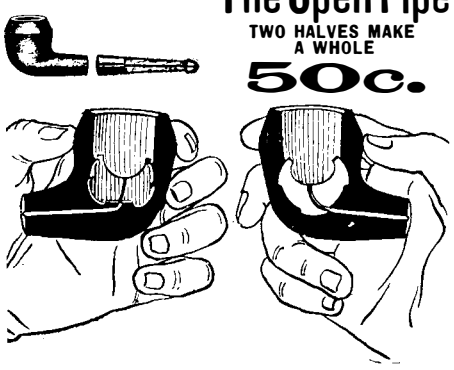

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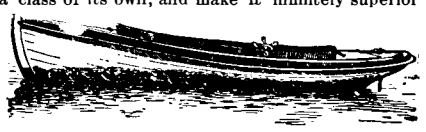

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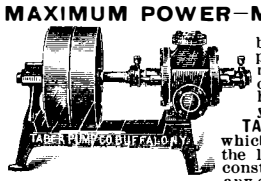

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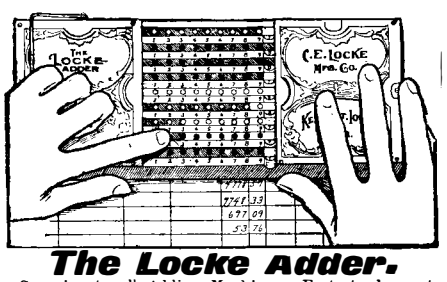

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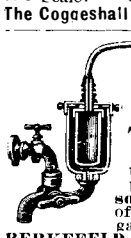

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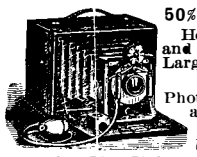

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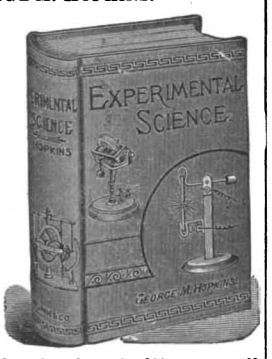

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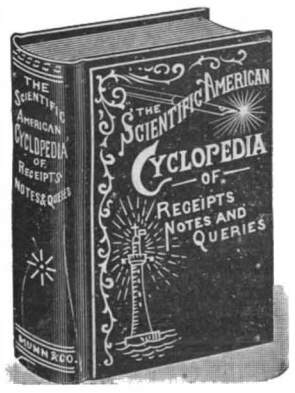

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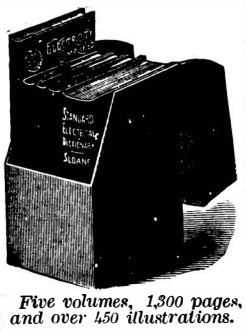

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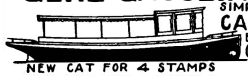

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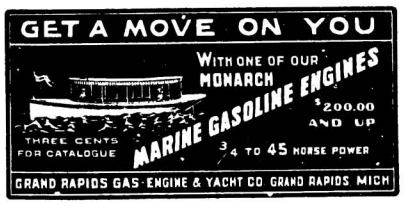
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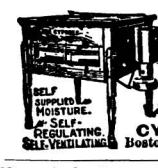

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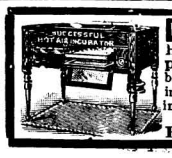

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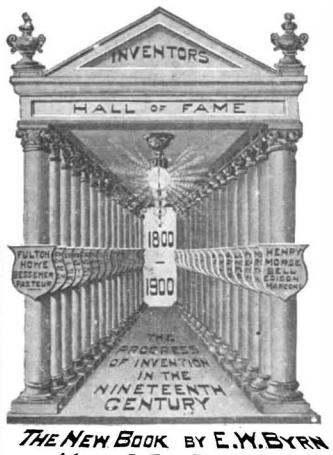

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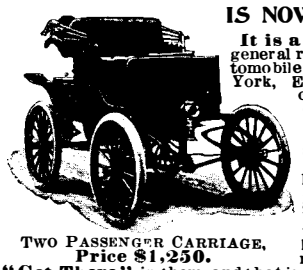

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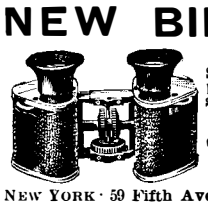

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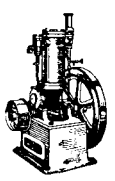

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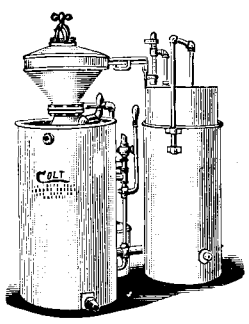

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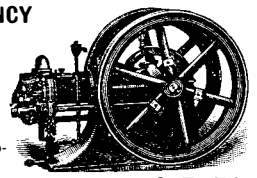

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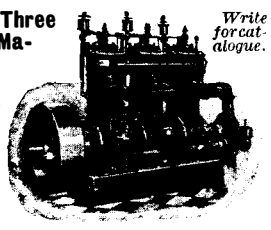

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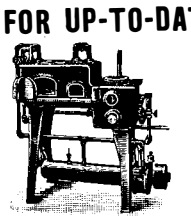

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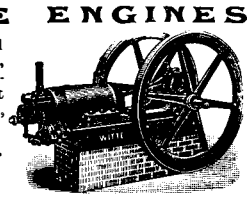

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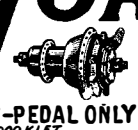

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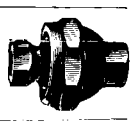

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